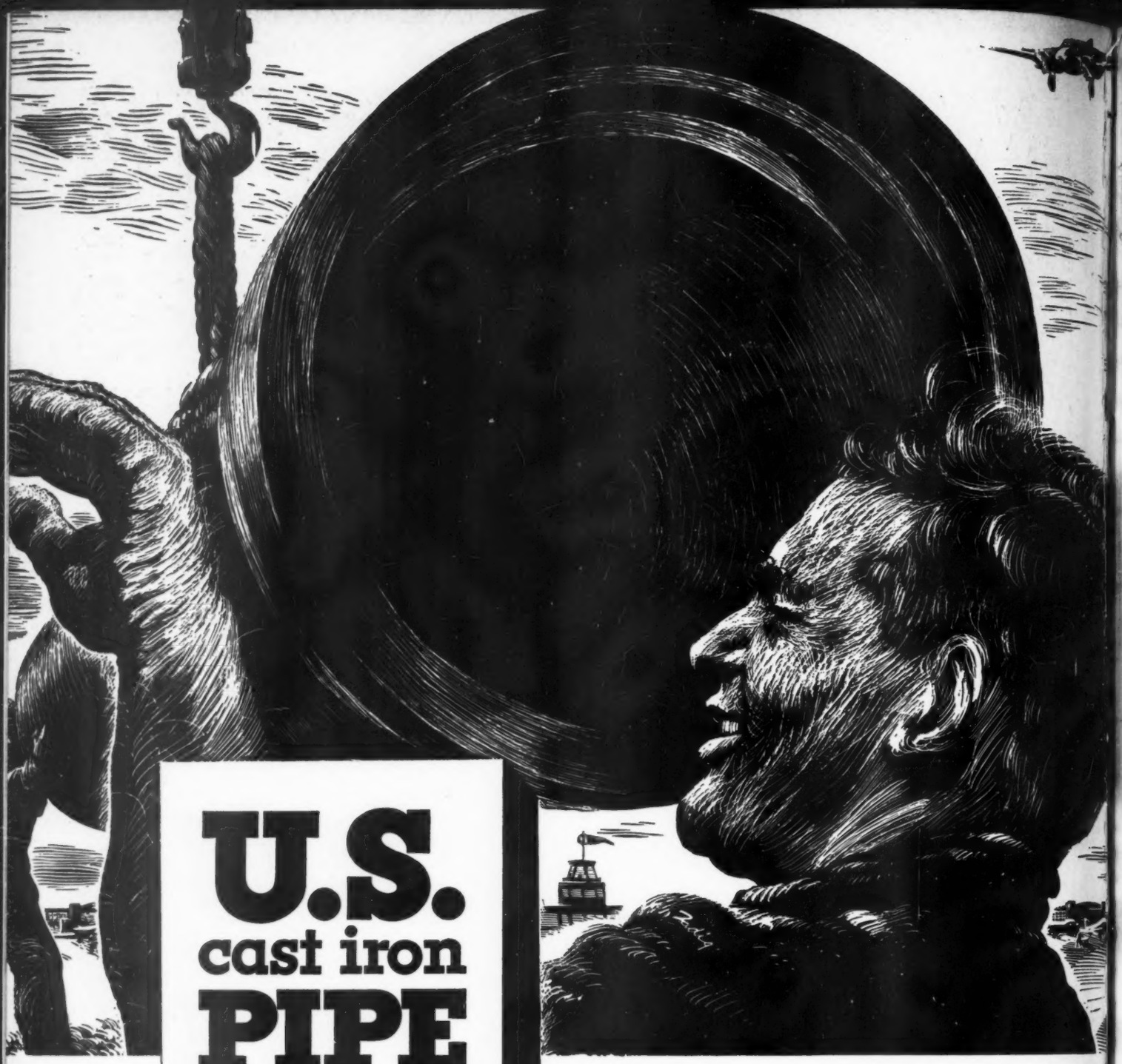
WATER WORKS & SEWERAGE

HBP ABC

THE SOUTH'S FINEST — RALEIGH'S NEW FILTER PLANT

Newark, New Jersey

Branches in Principal Cities



U.S. cast iron PIPE

Centrifugally or pit cast—for water works, gas, sewerage, drainage and industrial service.

Copyright, 1940 U. S. Pipe & Foundry Co.

INTO THE EARTH goes another length of cast iron pipe to perform faithfully its job as an underground conduit. Whether it will again see the light of day is dependent only on the changing plans of man. In place, or relocated elsewhere, it will serve out its century or more of useful life. True of the oldtime cast iron pipe—more than ever true of U. S. Super-de Lavaud Pipe and U. S. Pit Cast Pipe as manufactured today.

U. S. PIPE AND FOUNDRY CO. • General Offices: Burlington, N. J.

Plants and Sales Offices throughout the U. S. A.

● This "3C" Dead Front Sewage Pumping Panel is installed in an Eastern Sewage Disposal Plant.

Eleven motor starters, each equipped with a Disconnect Circuit Breaker and Thermal Overload Relay are housed in the neat cabinet. Suitable START-STOP Push Button with an indicating light showing which motors are operating are mounted in the Dead Front.

Doors which close flush with the surface of the panel provide easy access to all control apparatus.

The following motors are protected by "3C" Bulletin 6013 Starters.

3—10 H. P. Sewage Pump Motors
2—1½ H. P. Comminutor Motors
2—½ H. P. Clarifier Motors
1—½ H. P. Organic Return Motor
1—2 H. P. Cleaning Mechanism Motor
1—1 H. P. Collecting Motor
1—⅓ H. P. Blower Motor

Two additional Circuit Breakers are provided for future loads, and an 8 circuit flush type lighting panel and also a Recording Time and Pressure Instrument for three Sewage Pumps.

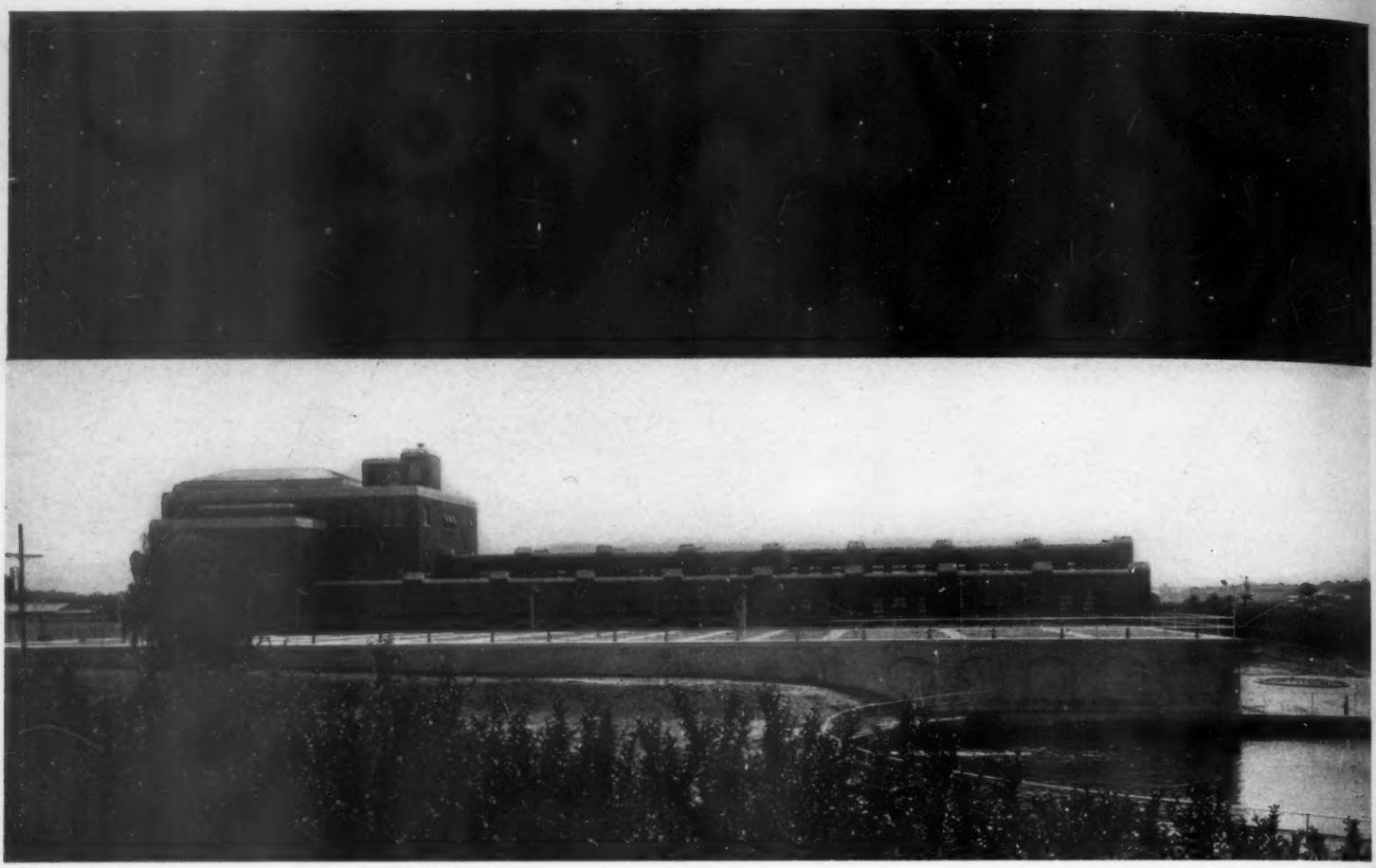
Similar panels, "3C" designed and built, are rendering splendid service in water works and sewage treatment plants all over America. Our nearest office will gladly consult with you.

OFFICES IN PRINCIPAL CITIES

THE CLARK CONTROLLER CO.

1146 EAST 152ND ST. CLEVELAND, OHIO

WATER WORKS & SEWERAGE, October, 1940. Volume 87. Number 10. Published monthly at 330 South Wells Street, Chicago, Ill., by the Gillette Publishing Company. Per copy, 25c. Subscription rate, United States $2.00 per year; Canada $2.40 per year; Foreign $3.00 per year. Copyright, 1940. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under Act of March 3, 1879.



"IT'S SIMPLEX AGAIN" in Raleigh, N. C.'s new half-million-dollar plant — with its 8,000,000 gallons daily capacity. Novel features of design—a model of mechanical efficiency, this plant is classed as the South's finest.

SIMPLEX is proud of the fact that its equipment, consisting of 8 — 1 million gallon gauge control units, 8 sand expansion indicators, 8 indicating and recording rate of flow and loss of head gauges, 5 Venturi Tube MO Meters, as well as Wash Water Controller and Wash Water Meter, plans an important part in the operation of this modern plant.

Charlotte, N. C., Rocky Mount, N. C., Greensboro, N. C., Sandusky, Ohio, Evansville, Ind., Gloversville, N. Y., Toledo, Ohio, Atlanta, Ga. (both under construction) are but a few recent installations where Simplex Equipment has been specified.

There is a Simplex Instrument for every need, whether in Water or Sewage Treatment. Simplex Engineers will gladly discuss your requirement with you at your request.

Let Simplex Engineers assist you in solving your control and metering problems.

RALEIGH'S NEW FILTER PLANT

●

Consulting Engineer—Wm. C. Olsen, Raleigh, N. C.

General Contractor—A. H. Guion Co., Charlotte, N. C.

Equipment Contractor—Roberts Filter Mfg. Co., Darby, Pa.

●

Top View Showing Operating Gallery Rate of Flow and Loss of Head Gauges, Sand Expansion Indicators.

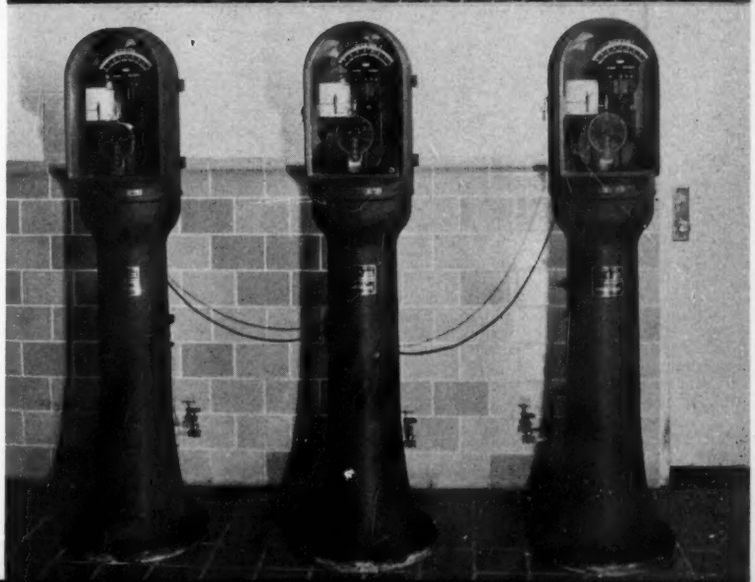
●

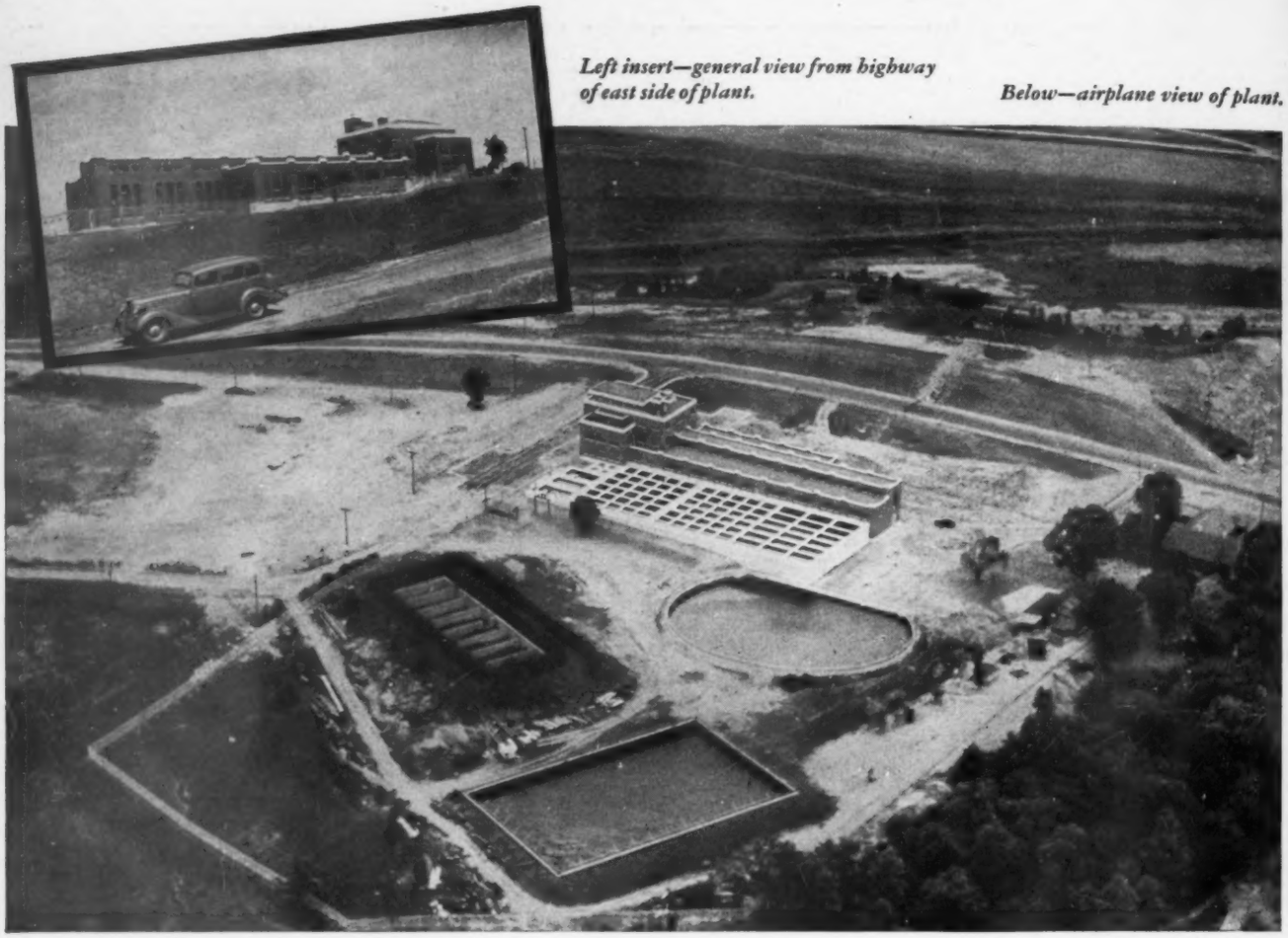
Center View Pipe Gallery with Simplex Effluent Rate Controller.

●

Bottom View High Service Discharge Meters.

●





Left insert—general view from highway of east side of plant.

Below—airplane view of plant.

NEW HALF-MILLION DOLLAR FILTER PLANT *at Raleigh, N. C.* USES MATHIESON CHLORINE AND HTH

• With its 8,000,000 gallons daily capacity, simplified pipe gallery, centralized control and other modern features, the new Ernest B. Bain water filtering and pumping plant at Raleigh, N. C. is a model of mechanical efficiency. Behind its efficient design and operation lie the years of practical experience of such men as Ernest B. Bain for whom the plant is named. Mr. Bain began his service with the Raleigh Water Company in 1897 and has been superintendent of the water plant since 1900.

It is also experience and efficiency which dictate the use in this big modern plant of Mathieson Chlorine for water treatment in the plant and Sanitation HTH for new mains and swimming pools. Mathieson Chlorine's high reputation among sanitation engineers is built on purity, dependability, trouble-free cylinders and valves, prompt delivery service. Sanitation HTH is a dry, free-flowing chlorine carrier containing more than 70% available chlorine; a quick, handy sterilizer for special and emergency jobs.

If you have not yet received the new Mathieson wall chart "Handling Chlorine Safely," write us for your copy today.

HTH comes in 5-lb. cans with replaceable caps, packed 9 cans to the case; also in 75-lb. drums.

THE Mathieson Alkali Works (INC)

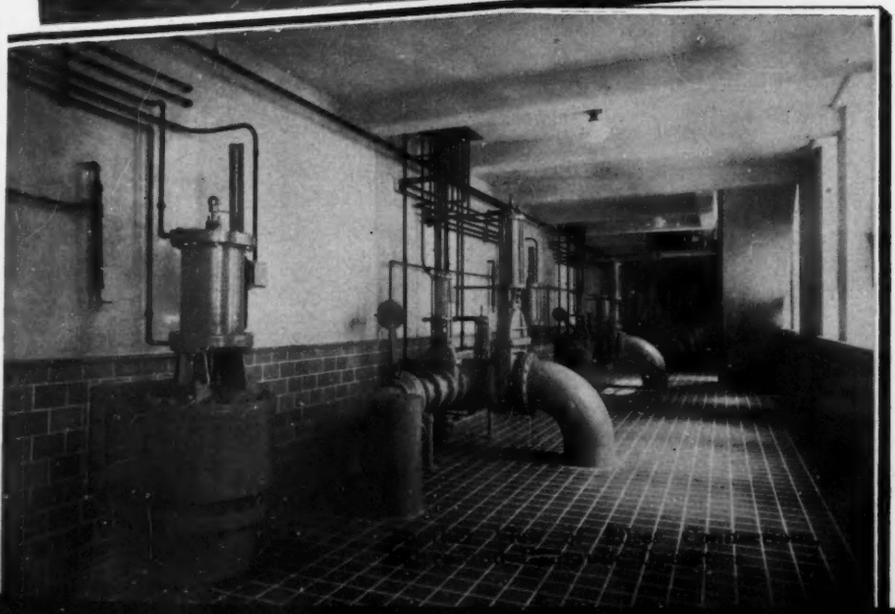
60 EAST 42ND STREET, NEW YORK, N. Y.

LIQUID CHLORINE . . . HTH . . . SODA ASH . . . CAUSTIC SODA . . . BLEACHING POWDER . . . BICARBONATE OF SODA . . . AMMONIA, ANHYDROUS and AQUA . . . PH-PLUS (FUSED ALKALI) . . . DRY ICE . . . CARBONIC GAS

Chapman Valves and Sluice Gates

Raleigh, North Carolina, Filter Plant
William C. Olsen, Designing Engineer

Interior view showing Pumps and Filter Connections. Note Chapman Valves and Operators



For This Modern NEW FILTER PLANT Raleigh, No. Car.

The new Raleigh Filter Plant is designe and equipped to meet the highest mode standards of performance and efficienc The quality and type of valve equipme selected for such a plant are importa factors in maintaining these standard Among Chapman products installed in th fine plant are:

Chapman Hydraulic Sluice Gates;

Iron Body Gate Valves, 6″, 10″ and 18 hydraulically operated;

Tilting Disc Checks for low pressure pump

20″ Beamed Waterway Regulating Ga Valve;

Hydraulic Cylinders for operating Valv and Sluice Gates.

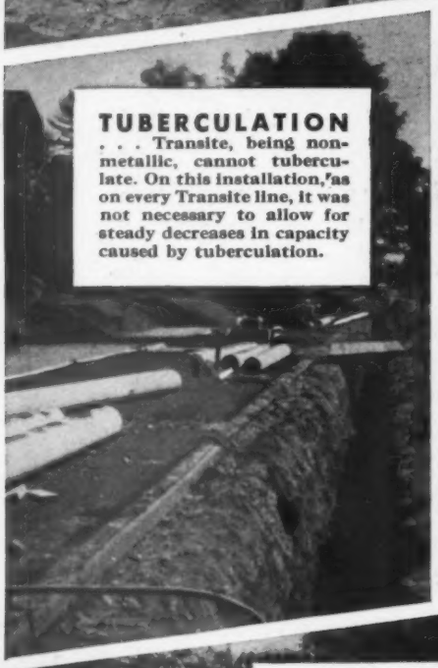
This standard Chapman equipment backed by the Chapman tradition of se vice and quality which for many years h made Chapman products outstanding the waterworks and sewerage field.

THE CHAPMAN VALVE
MANUFACTURING COMPANY
INDIAN ORCHARD, MASS.

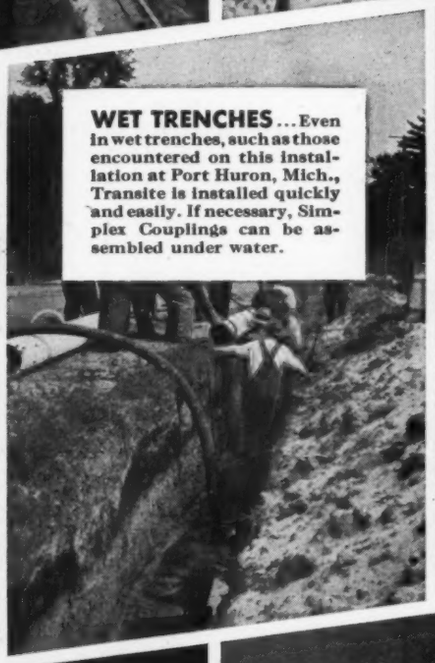
Most of YOUR water-pipe problems are listed here . . .

CORROSIVE SOILS . . . Unusually resistant to soil corrosion, Transite's asbestos-cement composition provides maximum protection against high upkeep charges.

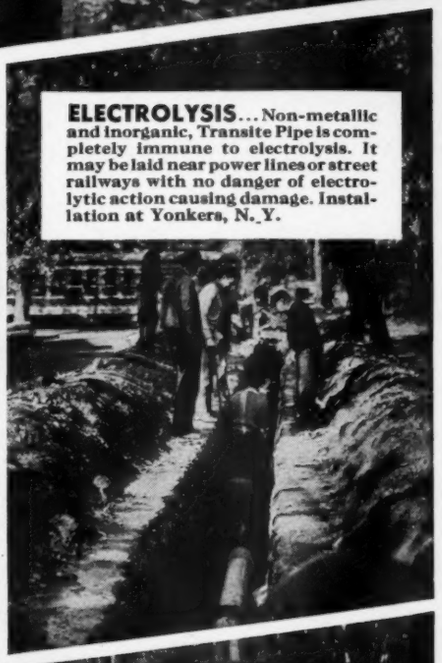
WIDE SWEEPS... Forming curves like this one at San Diego, Calif., is an easy job with straight lengths of Transite Pipe. Special fittings are unnecessary, for the flexibility of Simplex Couplings permits unusual deflection at joints.



TUBERCULATION . . . Transite, being non-metallic, cannot tuberculate. On this installation, as on every Transite line, it was not necessary to allow for steady decreases in capacity caused by tuberculation.

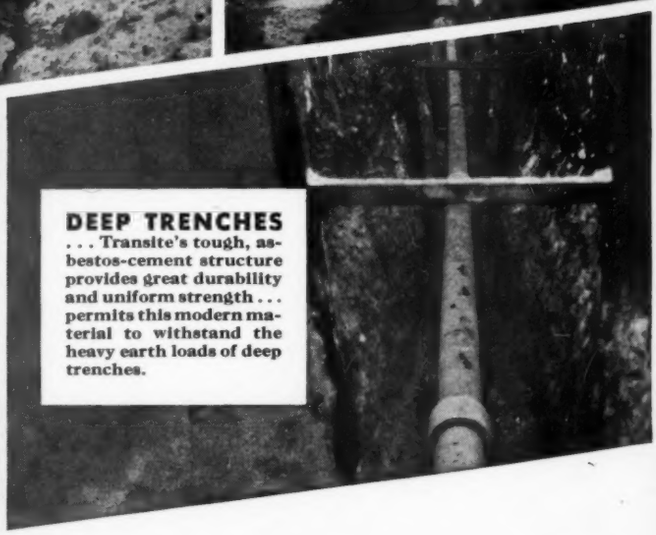


WET TRENCHES... Even in wet trenches, such as those encountered on this installation at Port Huron, Mich., Transite is installed quickly and easily. If necessary, Simplex Couplings can be assembled under water.



ELECTROLYSIS... Non-metallic and inorganic, Transite Pipe is completely immune to electrolysis. It may be laid near power lines or street railways with no danger of electrolytic action causing damage. Installation at Yonkers, N. Y.

VIBRATION... Flexible Simplex Couplings consisting of a Transite sleeve and two rubber rings effectively absorb vibrations set up by street traffic . . . assure maximum protection against leakage. This job is at East Orange, N.J.



DEEP TRENCHES . . . Transite's tough, asbestos-cement structure provides great durability and uniform strength . . . permits this modern material to withstand the heavy earth loads of deep trenches.

JOHNS-MANVILLE JM PRODUCTS **Johns-Manville**

JOINT LEAKAGE . . . On Transite lines, Simplex Couplings form tight joints that stay tight as long as the line is in service. Costly water losses caused by joint leakage are practically eliminated. This installation is in service at Dover, Delaware.

HANDLING COSTS . . . Transite comes in long, light, 13-foot lengths that make handling simpler and more economical. Smaller trucks carry greater footage . . . loading and unloading is fast and easy. Job illustrated was recently completed at Bryan, Texas.

INSTALLATION COSTS . . . No expensive mechanical equipment is needed to install J-M Transite Pipe. Unskilled crews, using a simple chain puller, can finish jobs rapidly at low cost. This job picture taken at Chicopee Falls, Mass., shows the simplicity of Transite'sassembly.

See how you save with TRANSITE!

EVEN if you're faced with *all* these conditions in your community, there's no reason to pay excessive installation, maintenance or operating charges. The right pipe can play an important part in reducing these expenses on any water line. And that's why more and more waterworks engineers and operators are specifying J-M Transite.

Made of asbestos and cement, Transite Pipe saves money at every stage of water-line operation. Its long lengths, light weight and simple assembly assure fast, economical installation, even when unskilled crews are used. Maintenance stays low, for Transite combines uniform strength and durability with unusual corrosion resistance. And because Transite cannot tuberculate, it maintains its smooth interior (flow coefficient C=140) indefinitely . . . makes permanent savings on pumping costs.

• • •

Before you plan a new water line or extensions to your present system, you should have full details on J-M Transite Pipe. Write for brochure TR-11A. And if you're interested in better sewage disposal at lower cost, send for Transite Sewer Pipe brochure TR-22A. Johns-Manville, 22 East 40th Street, New York, N. Y.

TRANSITE PIPE

THE MODERN MATERIAL FOR WATER AND SEWER LINES

WELDED STEEL PIPE

. . . the MODERN SOLUTION to Water Transmission Problems

The use of welded steel pipe to meet water transmission requirements in municipal and industrial water systems is becoming more and more widespread. For example, the 30-inch diameter sections illustrated above are part of a shipment made to Muskegon Heights, Mich., where they are being used for the water supply intake in Lake Michigan.

The high tensile strength of steel pipe makes it particularly well adapted for high pressure line service and for large water mains in locations where they are subject to shock. It is often desirable to obtain as long lengths of pipe as can be handled conveniently. On the Muskegon intake job, for example, two standard 60-foot sections were welded together in the shop and shipped in 120-ft. lengths.

Our organization has taken definite steps to assure the production of highest quality fabricated steel pipe, designed to meet the strictest requirements. To handle the increased demands for this type of work, new plant facilities have been built, complete with the most modern equipment to insure fast production and prompt deliveries. Let us quote on your complete requirements.

IN CIRCLE: View showing interior of a 60-ft. section of pipe being coated at our Chicago plant. RIGHT: Exterior of 60-ft. section being coated with specially designed pipe coating machine. BELOW: View in pipe shop showing sections being welded together to form 60 ft. lengths.

CHICAGO BRIDGE & IRON COMPANY

Chicago	2198 McCormick Bldg.	Birmingham	1586 North 50th Street	Philadelphia	1644-1700 Walnut St.
New York	3390-165 Broadway Bldg.	Tulsa	1646 Hunt Bldg.	Boston	1548 Consolidated Gas Bldg.
Cleveland	2262 Rockefeller Bldg.	Houston	918 Richmond Avenue	San Francisco	1083 Rialto Bldg.
Dallas	1679 Praetorian Bldg.	Detroit	1551 Lafayette Bldg.	Los Angeles	1455 Wm. Fox Bldg.

Plants at BIRMINGHAM, CHICAGO, and GREENVILLE, PA. *In Canada:* HORTON STEEL WORKS, LIMITED, FORT ERIE, ONT.

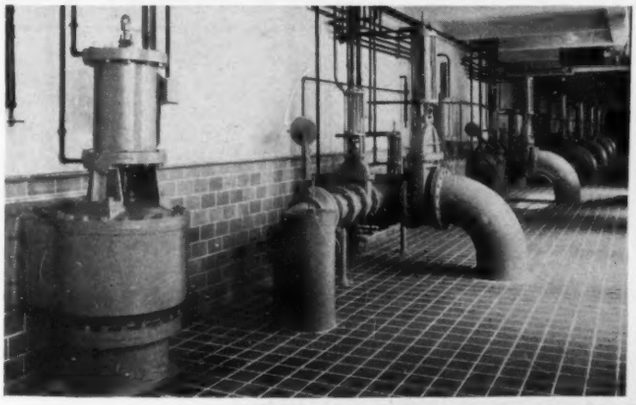
ULTRA-MODERN
Municipal Filter Plant
ERNEST B. BAIN WATER WORKS, RALEIGH, N. C.

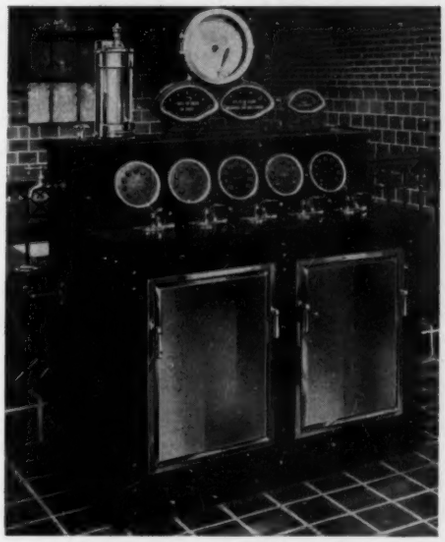
ROBERTS EQUIPPED THROUGHOUT

Designing Engineer
WM. C. OLSEN
Raleigh, N. C.

General Contractor
A. H. GUION & CO.
Charlotte, N. C.

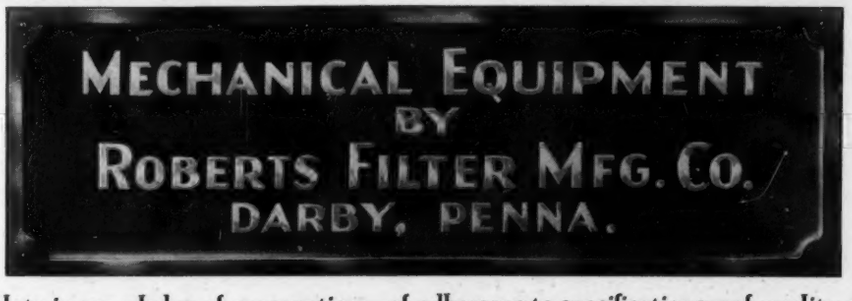
In conception of idea, in thoroughness of design, in beauty of appearance, in economy of construction, in assured operating efficiency, this is truly the filter plant of tomorrow. Attractive, compact, efficient, the BAIN FILTER PLANT is an impressive example of modern development in the art of water purification.





THE ROBERTS ELECTRIC OPERATING TABLE

Keeping a-pace with modern improvement, we present for the first time the Roberts Electric Operating Table. The position of all hydraulic valves is indicated by "bull's-eye" lights . . . red for closed, green for open, yellow for intermediate points. No unsightly mechanical contrivances, no cords to stretch or break, no troublesome pulleys—this is tomorrow's means of indicating hydraulic valve position.



This name plate is our pledge of cooperation—of adherence to specifications—of quality of materials —of excellence of workmanship—of continuing interest long after the contract price has been paid.

They Started Something!

THE MEN who devoted their efforts to forwarding the science of photography —from its rudimentary beginning in the *camera obscura* in 1569 to its highly developed form today—made striking contributions both to human happiness and to industrial progress. Photography today is a hobby that has brought greater pleasure to millions of people — and through the medium of the motion picture it entertains countless millions more. It is the foundation of giant industries, and its use has opened new fields of knowledge for almost every other industry. High-speed photography to study the motion of machines, microphotography and X-ray photography—these are a few of its major industrial applications.

When EBG engineers first produced Liquid Chlorine commercially in this country, they too made a major contribution to human welfare and to industrial development. New safeguards against the danger of waterborne diseases were made possible by the use of EBG Liquid Chlorine to purify the water supplies of hundreds of communities. Today EBG Liquid Chlorine is rapidly expanding its usefulness in the field of sewage sterilization, and thus is helping to combat pollution of streams and rivers. And both the paper and textile industries find in EBG Liquid Chlorine an efficient and economical bleaching agent.

The first cylinder of Liquid Chlorine made by EBG in 1909.

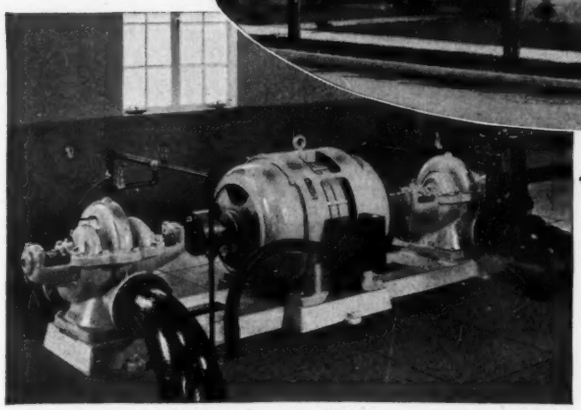
First to produce Liquid Chlorine in this country, first to adapt it to many of its major uses, EBG engineers have the advantage of extra years of experience. That experience works to *your* advantage when you buy EBG Liquid Chlorine.

ELECTRO BLEACHING GAS COMPANY
Main Office: 60 East 42nd Street, New York, N. Y.
Plant: Niagara Falls, N. Y.

EBG Liquid Chlorine
FIRST IN THE COUNTRY

"DOWN BY THE Waterworks"

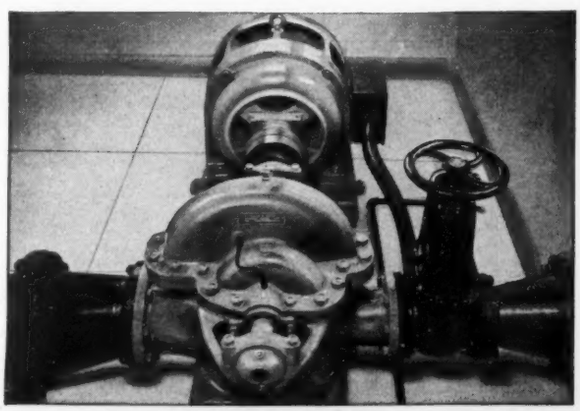
IS A SHOW PLACE IN SAN BERNARDINO



Above are two of the F-M horizontal booster pumps, connected in series and powered by a 100-h.p. F-M Motor in the Antil station. When tested for acceptance, this unit far exceeded its guaranteed efficiency. Operating at a head of 200 feet, it discharged 1503 g.p.m.

INSTEAD of one central pumping plant, the water department of San Bernardino, California maintains ten. Some are located in residential sections and housed in buildings that harmonize with surroundings. Multiple plants make it possible to maintain more equal pressure under peak loads and prevent interruption of service over the entire system. San Bernardino recently modernized one of its plants and built one new station.

Low initial cost plus low maintenance cost that results from improved design and precision construction have made F-M Pumps standard wherever pumping equipment is used. The F-M line is complete. You describe the problem—we have the right pump for it. Fairbanks, Morse & Co., Department 115, 600 S. Michigan Ave., Chicago, Ill. Branches and service stations throughout the United States and Canada.



At the left is the neat layout of the new F-M equipment installed in the new Mt. View station—one F-M 6" x 8" horizontal booster pump direct connected to a 75-h.p. F-M Motor.

7671-PA58.17

FAIRBANKS-MORSE

DIESEL ENGINES
PUMPS
ELECTRICAL MACHINERY
FAIRBANKS SCALES
RAILROAD EQUIPMENT

WATER SYSTEMS
WASHERS-IRONERS
FARM EQUIPMENT
STOKERS
AIR CONDITIONERS

F M

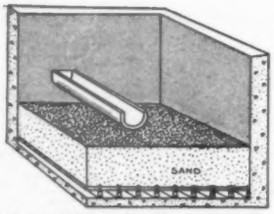
Pumps

Designing a new filter plant?

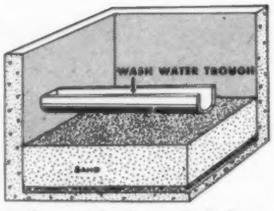
Improving an old one?

INVESTIGATE THE BENEFITS OF THE ALOXITE BRAND POROUS UNDERDRAIN SYSTEM

1. *Elimination of filter bottom troubles... protection against loss or upset of filter media... no corrosion.*
2. *Longer filter runs... uniform back wash.*
3. *Lower pumping costs... reduced heads.*
4. *Lower cost of construction.*



Filter with plain plates supported on concrete piers



Filter with channeled plates

Now being proved in more than 40 separate installations throughout the world

THESE benefits are realized through the inherent simplicity of design of the Aloxite Brand Porous Underdrain System which results in the complete elimination of graded gravel and the reduction of all vertical dimensions. Our sanitary engineers will gladly furnish consulting engineers, plant superintendents and others who are interested with further details. Write direct to the Niagara Falls office.

POROUS CARBORUNDUM PRODUCTS

THE CARBORUNDUM COMPANY

REG. U. S. PAT. OFF.

Niagara Falls, N. Y.

Sales Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids

(Carborundum and Aloxite are registered trade-marks of and indicate manufacture by The Carborundum Company)

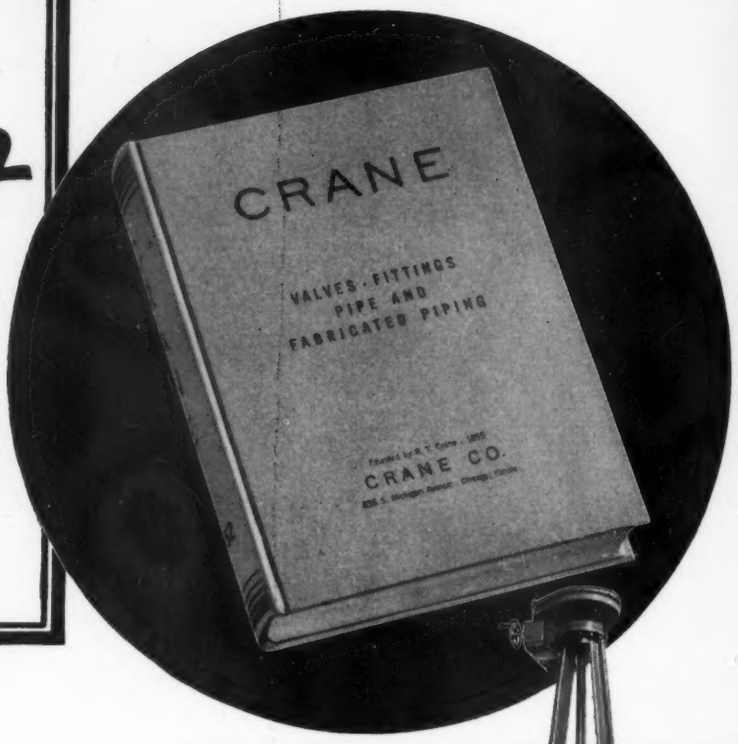
Leading sewage engineers have found in the new DIAMOND FERRIC CHLORIDE the ideal material for sewage coagulation and sludge conditioning. Steps up the removal of settleable and suspended solids, thereby increasing plant capacity and efficiency.

DIAMOND FERRIC CHLORIDE is available in 60% crystals packed in 300 and 500 lb. barrels, and in tank cars of 38-45% solution. Try Diamond Brand on your next order.

DIAMOND ALKALI COMPANY

Pittsburgh, Pa., and Everywhere

38,000 Answers TO YOUR FLOW-CONTROL PROBLEMS



WATER works and sewerage problems are flow-control problems—and Crane can help you solve them! In the great Crane line, there are more than 38,000 individual piping items. Each is designed with the highest adaptability to specific service needs. Here is equipment for every water works and sewage plant application. Here are sluice gates of advanced design—valves of every type, large and small, with all modern accessories and operating mechanisms—fittings and specialties in a complete assortment of practical patterns.

Under rigid laboratory control, with the aid of newest scientific techniques, Crane-Equipment is produced in an almost endless range of materials—from iron, steel and brass, to the finest alloys known.

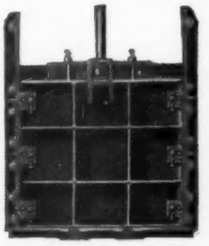
That's how Crane helps you solve piping problems: by making available equipment of exactly the right design and materials for each service condition. And there lies the secret of greater plant efficiency and low-cost flow control. Added assurance of dependability in these products is Crane's 85-year manufacturing experience.

For an efficient solution to any water or sewage handling problem, consult your Crane Catalogs, or call in your Crane Representative.

No. 777 Crane Light Standard iron body double disc gate valve. Brass trimmed.

66-in. motor-operated Crane cast iron gate valve.

Crane No. 449½ Low Pressure brass gate valve. Wedge disc, non-rising stem.



Crane Sluice Gates have no rivets or screws to cause scoring of seats.

1940 our 85th YEAR

CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVE., CHICAGO

VALVES · FITTINGS · PIPE
PLUMBING · HEATING · PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

Sewer Troubles Vanish

WHEN YOU USE THIS PIPE

• Why worry about those difficult sewer conditions? You can install Asbestos-Bonded ARMCO Sewer Pipe and forget them. This durable pipe gives you *extra* protection against corrosion or erosion and has adequate strength to safely meet every sewer requirement.

Shifting soils or unstable foundations will never disjoint an ARMCO sewer. Sturdy band couplers see to that by producing a continuous conduit of balanced strength and design. Joints can be made soil- and water-proof. What's more, because of its flexible corrugated metal design, you can install ARMCO Pipe in deep trenches or under shallow cover without fear of crushing or breaking. Material durability is assured by a smooth bituminous pavement that guards the bottom against erosion and a full coating of the same material for protection against acid, alkalies and gases. Lasting adhesion of the bituminous coating is made possible by ARMCO's exclusive Asbestos-Bonding process.

Set your mind at rest on that next tough sewer job by specifying Asbestos-Bonded ARMCO Pipe. Then you'll be protected. And remember, that with all its advantages, ARMCO Pipe usually costs less in the long run. Write us for facts. Armco Drainage Products Association, 5028 Curtis St., Middletown, O.

Down to Davy Jones locker goes this 36-inch Asbestos-Bonded ARMCO outfall sewer. Strong, tight joints prevent sand from entering to clog the line and eliminate the danger of disjointing on the shifting bottom. Submerged trestles were used in the deeper water to provide a uniform slope.

ARMCO

ASBESTOS-BONDED

ARMCO SEWER PIPE

What'll we do?

Our water supply is polluted . . . and it connects with the city mains!

HUNDREDS of thousands of citizens were in danger. The distribution system of a great city was interconnected at one point with a private water supply . . . and the latter had become dangerously polluted!

A steel piling driven into the ground had shattered a pressure sewage main. Sewage flowed into a private water system which was cross connected to the municipal water supply. There was no sure way to determine whether any of the polluted water had reached the city mains . . . but there *was* a quick, dependable method right at hand to sanitize the supply. The municipal plant was amply prepared with Perchloron!

Perchloron, solution barrels, and a pump were immediately loaded on a water works truck and set up at a fire hydrant near the potential source of pollution. Perchloron solution was pumped into the city main, providing emergency chlorination that protected the population against danger.

That is an instance of the way Perchloron fits in. Plants in every section of the country have found how well it pays to be prepared with Perchloron. They use it, not only for emergency chlorination, but for sanitizing new mains, for clear wells and filters, and for swimming pool sanitation.

Perchloron, a dry, free-flowing granular material, contains more than 70% available chlorine. It is stable, concentrated, uniform. Ready-to-use solutions are quickly prepared by dissolving it in tap water. Packed 9 handy-sized cans to the case, each can with Kork-N-Seal cover. Also in 75-lb. drums. Write for free booklet. Pennsylvania Salt Mfg. Co., Widener Building, Philadelphia, Pa.
New York • Chicago • St. Louis
Pittsburgh • Tacoma • Wyandotte.

Perchloron

PENNSYLVANIA SALT
MANUFACTURING COMPANY
Chemicals

REPORTER: What's the lowdown, captain?

FIREMAN: Can't blame the man—it's the hydrant!

"How's that? The hydrant knocked him off?"

"Not exactly—it was the shock of the water . . . whipped the hose when it was turned on. Down in this end of town, you see, we still have hydrants that let the first water through with one tremendous rush. The man who fell wasn't familiar with that shock—the rest of the city is all Ludlow equipment . . . slide-gate type hydrants, that give us quick water with minimum shock."

LUDLOW HYDRANTS

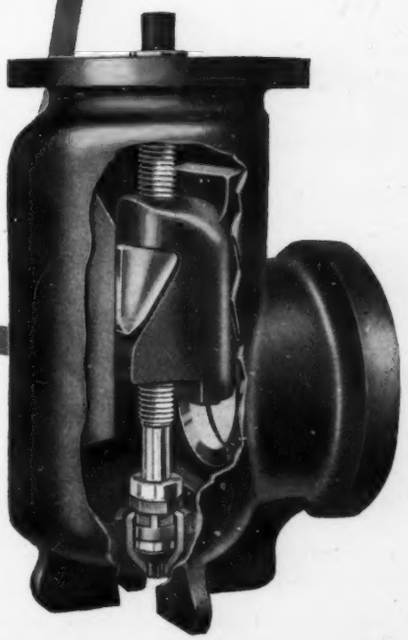
The slide gate principle, developed and perfected by Ludlow, insures *complete security* in fire hydrants. It provides *all* these advantages:

Quick Water with least possible shock. Proper shut-off without water hammer.

Proper Drainage. Hydrant automatically drained at *lowest* point when closed.

No Flooding. Accidental breaking of the hydrant, such as might result by collision from a heavy truck, will not cause flood since the gate when closed is wedge-locked.

Easy Inspection and Servicing without unscrewing anything below the ground level. All working parts removed as one unit by lifting stem through top of hydrant.



NON-CLOGGING DRAINAGE

Closure of hydrant automatically opens this drain, which is located at the lowest point. It remains open until automatically closed by the action of opening the hydrant.

Ludlow Valves

The parallel seat, double wedge type slide gate valve, developed and perfected by Ludlow, has been the universally accepted construction in all waterworks valves for nearly three-quarters of a century. It provides *all* these essential benefits:

Smooth, Positive Operation. Gates positioned *directly* opposite ports before wedging, and entirely unwedged *before* being raised.

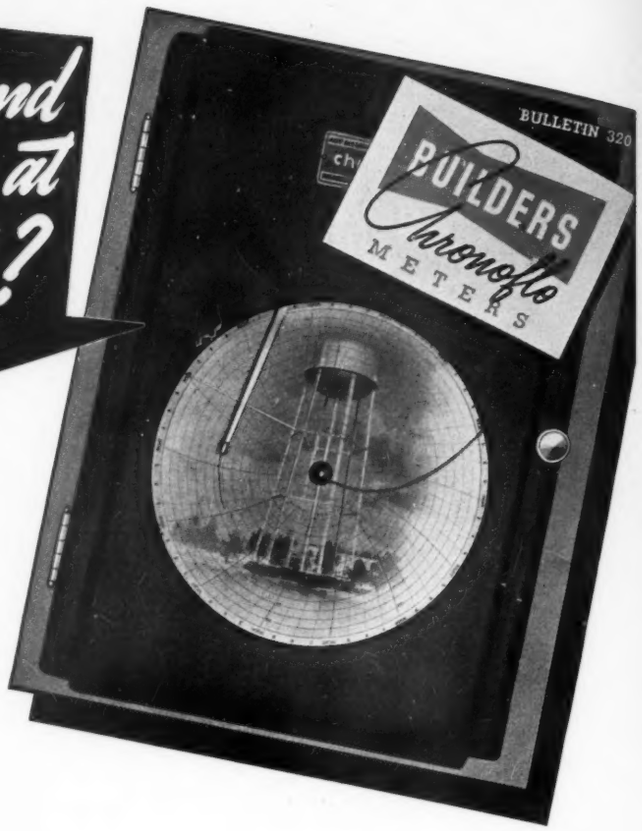
Positive Closure — even after years of service in the open position; flexible-action gates *self-adjusting* to seats.

Self-Cleaning. Rings cleaned *throughout entire stroke*. No *internal guides* to cause foul-up.

Ready Replacement of Parts. Simple construction and ample tolerances make possible ready replacement of parts.

The LUDLOW VALVE MFG·CO·INC· SINCE 1866 TROY·N·Y·

Are your tanks and reservoirs working at only 50% capacity?



If so, you'll want a copy of Bulletin 320 telling how the Chronoflo Long Distance Meter will:

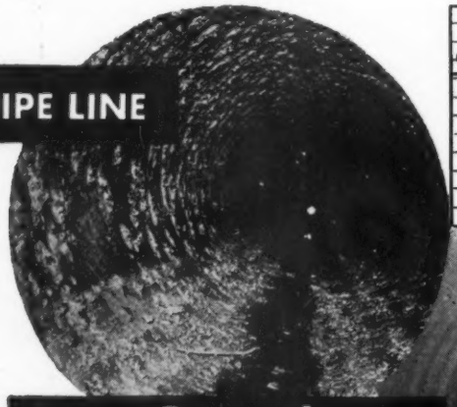
1. Bring level readings into your office.
2. Automatically control pumps to keep tanks and reservoirs *FULL*.
3. Insure maximum fire protection with full storage.
4. Prevent accidental overflows.
5. Reduce power demand by having full tank at beginning of daily peak load.

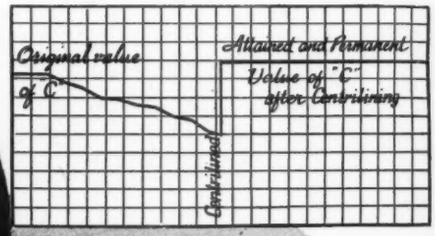
Other important Chronoflo Meter applications include: Flow - Summation - Position - Pressure - Temperature - Weight.

Ask for Bulletin 320

BUILDERS IRON FOUNDRY • **PROVIDENCE** RHODE ISLAND

THIS TUBERCULATED PIPE LINE





INTERIOR corrosion and tuberculation are two of the greatest sources of trouble in water-supply lines.

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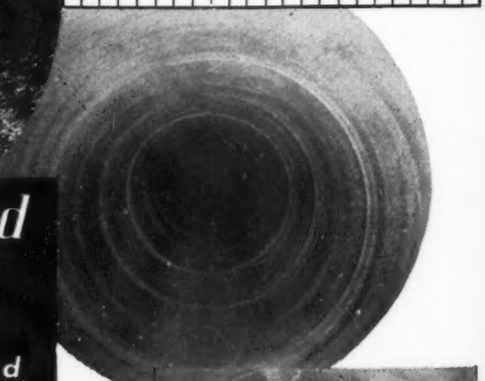
Write us for information regarding the application of the Centriline Process to your pipe-line corrosion and tuberculation problems.

when *Centrilined* — will have its carrying capacity permanently restored



- *Speedy*
- *Economical*
- *Permanent Results*

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WATER WORKS & SEWERAGE

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EDITORIAL OFFICE
155 East 44th Street, New York, N. Y.
L. H. Enslow, Editor

COMING!

"Lime and Lime Slaking"

Discusses fundamental considerations in the choice and handling of lime in water and sewage treatment which should enable operators to select or specify the lime of characteristics and quality most suitable and economical for the use to which it is to be put. Particular attention is given to the matter of how most effectively feed and slake quick lime and apply the "cream of lime" suspension resulting from proper manipulation in slaking control. The author—
H. E. LORDLEY, Manager,
Filtration Plant, Richmond, Va.

"Thawing Mains—and Service Lines"

Is an article scheduled to appear in advance of the arrival of "Old Man Winter." Coming from a plant manager of considerable experience this article will bring up to date the basic considerations and operations of proven merit, economy and safety in thawing mains and service lines electrically. It presents useful data, gives recommended procedures, and outlines precautions to take, based on thawing experience. In brief it constitutes "A Guide in Electrical Thawing." The author—
FRANK C. AMSBARY, JR., Manager,
Illinois Water Service Co., Champaign, Ill.

"Activated Sludge Bulking"

Constitutes a discussion of activated sludge bulking phenomena and the prevalent causes thereof. It also suggests remedial measures for prevention as well as correctives. The author—
H. HEUKELIKIAN, Associate,
N. J. Expt'l Station, New Brunswick, N. J.

"The Water Supply Betterments of Tucson"

Constitutes "a look behind the specifications," as the authors express it, of the water system betterments recently completed by Tucson, Arizona. In this article an interesting slant is the frankness with which the authors reveal what was *wrong*, as well as what was *right*, in the methods pursued and materials or equipment employed. The authors are—
JOHN A. CAROLLO, Consulting Engineer,
Phoenix, Arizona;
PHIL J. MARTIN, Sup't of Water and
Sewage, Tucson, Arizona

"Field Cost Keeping"

Is filled with helpful suggestions to simplify this subject that appears to needlessly frighten the average water works or sewerage operator. The author, who has been "keeping track" of costs on construction jobs for a number of years, speaks in a readily understandable language to help others to see that while "Cost Keeping" sounds formidable enough, it is not any more difficult than "keeping track." He is—
WALDO M. PORR,
Asplund Construction Co. of Enid, Okla.

"Experiences With Publicity Methods"

Constitutes a story of how the successful program of "selling" the Portland Water District supply and services to the public was accomplished, at reasonable and justified expense. The article comes from—
FRED. J. RENY, General Manager,
Portland Water District, Portland, Me.

"America's Softening Plants of Special Interest"

Are to be the subject of a series of articles which are being prepared by the author from his notes covering items of particular interest observed or learned when visiting the more important water softening plants in the United States. The author in his coast to coast "round-up" of water treatment plants was able to collect data from which his timely and interesting articles, highlighting design and operating experiences at such plants, has been developed. His observations were made as an operator seeking the best that has been produced in plant design and treatment practices, in consequence being of special interest to designers, operators and those considering or contemplating softening in the near future. The author—
L. J. ALEXANDER, Engineer of Operation
Southern California Water Co., Los Angeles

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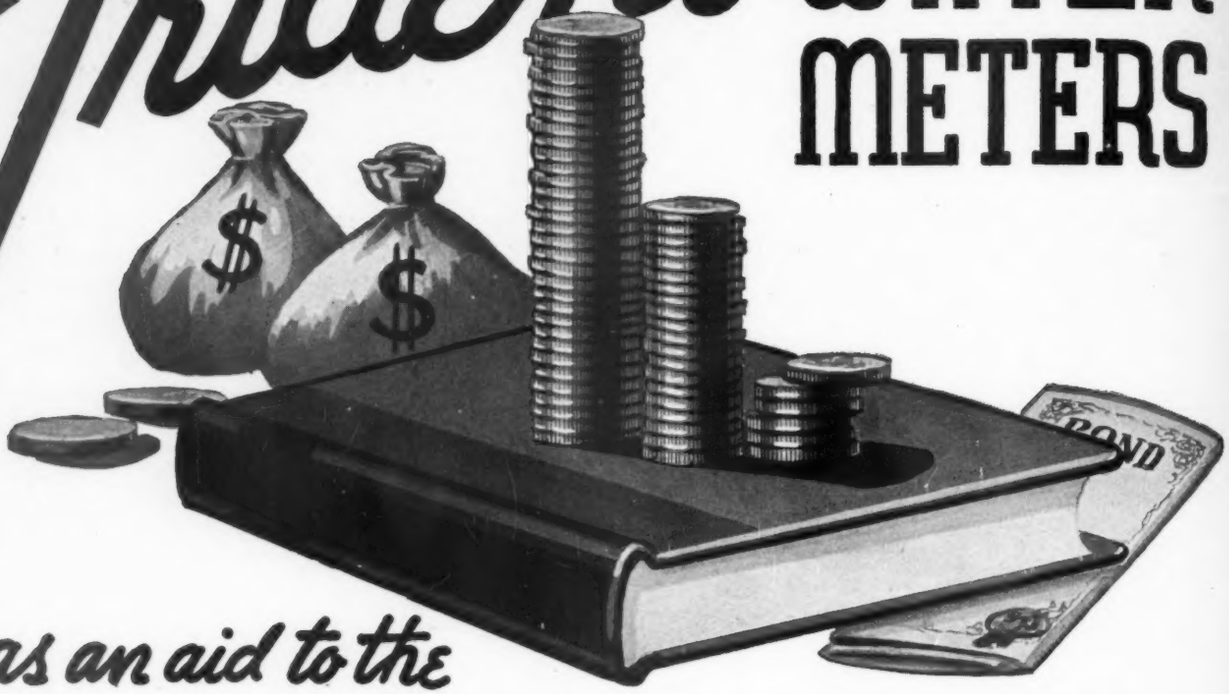

as an aid to the CITY COMPTROLLER

IN MANAGING the finances of a city, one of the Comptroller's interests is in seeing that the costs of the Water Department are cut down, while its income is increased. This Department is at its best when it is not a burden on the tax-payer, its rates are reasonable, and the market for its water bonds is strong.

Trident Water Meters, by their sustained accuracy, develop maximum revenue from water. Since they never become obsolete, they cut down depreciation. Because of interchangeability of parts, they eliminate capital tied up in spare parts for old models.

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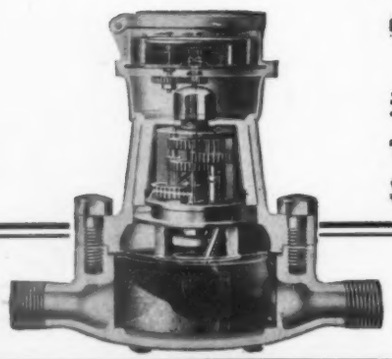

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WATER WORKS & SEWERAGE

VOL. 87, NO. 10 *A Gillette Publication* OCTOBER, 1940

THE NEW FILTER PLANT AND PUMPING STATION AT RALEIGH, N. C.

Named in Honor of Water Works Superintendent of Many Years Service

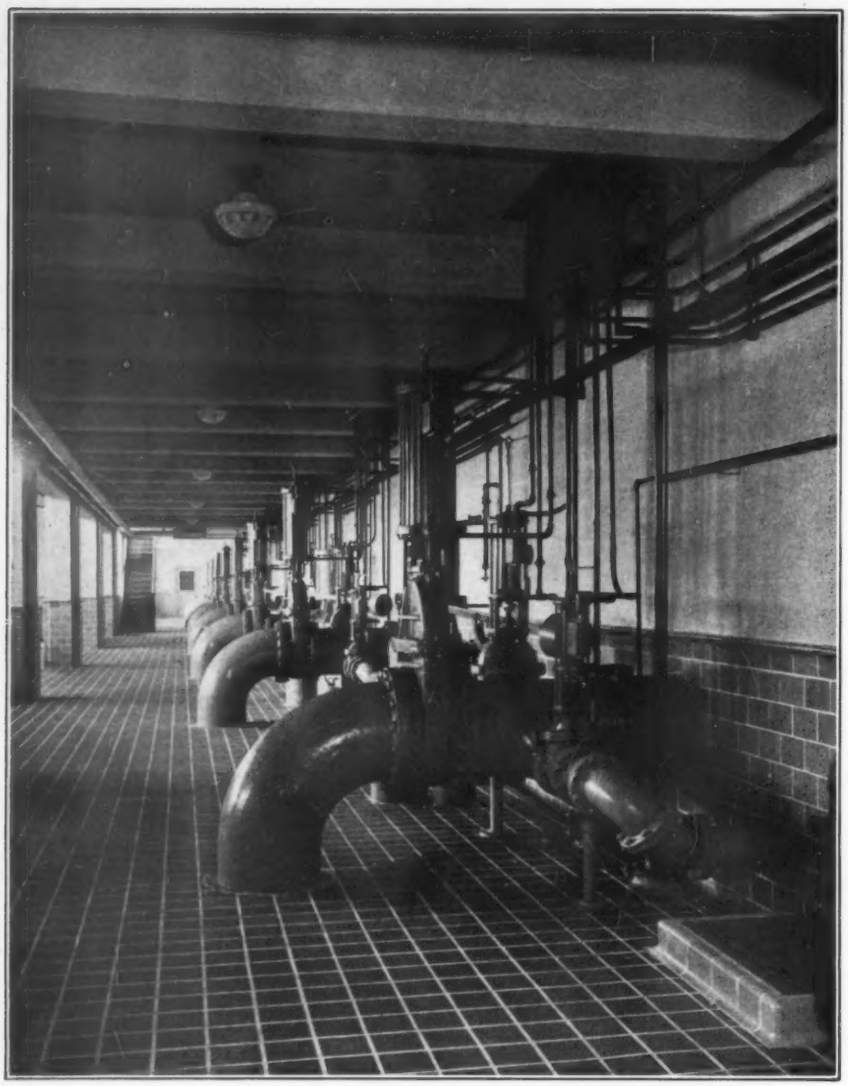
By WM. C. OLSEN, C.E.
Designing and Consulting Engineer
RALEIGH, NORTH CAROLINA

THE new "Ernest Bain Filter Plant and Pumping Station" of the City of Raleigh, North Carolina, was completed May 31, 1940.

Before proceeding with a description of this plant it seems proper to highlight the history of the Raleigh Water Works, dating from its inception. In the year 1885 a committee was appointed by the City Board of Aldermen to investigate the matter of procuring a public water supply and to ascertain types and character of water works systems in operation by other cities, and to employ an engineer to determine the best and most feasible source of supply for a water works system for the city. Walnut Creek was selected as the source of supply and on November 11, 1886, the Board of Aldermen adopted the ordinance providing for a water supply for the city and granted a 20-year franchise to the National Water Works Construction Company of Dayton, Ohio, for the construction and maintenance and operation of a water works system for the city.

The Author

The New Raleigh Plant
(Viewed Across the Flocculation and Sedimentation Basins. In the Left Foreground the Old Clear Water Storage Basin Retained).



The Pipe Gallery

(It Faces Into the Pump Room on Left. Note Absence of Valve Indicator Chords and Minimum of Piping).

Raleigh's First Plant

The original water works of Raleigh consisted of an intake on Walnut Creek at a point near the Rhamkatt Road, a 15-inch and a 14-inch pipe line, 6,700 feet long, to pumps located at the former site of Jones and Powell's Mill. The purification and pumping plant consisted of a Hyatt filter, a 1,500,000-gallon reservoir, two water turbine-driven duplex pumps, two duplex compound condensing pumps, and two boilers, all of which equipment was housed in a brick building approximately 38 feet by 80 feet in plan. This plant had a capacity of 2,000,000 gallons per day and from the plant the water was delivered through a 14-inch pipe line approximately to the city limits, and from this point reduced to a 12-inch pipe line, which continued to a water tower constructed on Morgan Street. The water tower consisted of a 100,000-gallon steel tank 30 feet high and 24 feet in diameter set on a brick tower. The high water level in the tank was at elevation 115 feet above the ground.

Within the city limits there were constructed about 11 miles of pipe varying in size from 4 inches to 12 inches in diameter, constituting the distribution system and to which were connected 120 fire hydrants. The construction of the water works plant and system was completed in October, 1887, at which time Raleigh's population was 13,000.

On November 12, 1886, the Raleigh Water Company was incorporated to take over the franchise of the National Water Works Construction Co. and to operate the plant. The records are not very clear in connection with the operation of the plant by the Raleigh Water Co., but it was noted that in the nine years following its organization a total of 644 consumers had been connected with the system.

On November 26, 1901, the Wake Water Co. was organized and took over the plant and system of the Raleigh Water Co., the purchase price being $350,000. The Wake Water Co. operated the plant and system until October, 1912, when it was placed in receivership. The plant and system were taken over by the City of Raleigh through arbitration proceedings in June, 1913, the purchase price set by the arbitrators, namely $250,000.

At the time the city acquired the water works plant and system, water was furnished to the filter plant from an intake in Walnut Creek, located approximately 2,700 feet below Lake Raleigh Dam, through 10,000 feet of 18-inch pipe to a suction chamber at the plant. At that time the plant consisted of a rapid sand type filter plant and steam-driven pumping station, a concrete settling basin 144 by 44 feet and 11 feet deep, and a masonry clear water reservoir with a capacity of approximately 2,000,000 gallons. The filter plant consisted of six reinforced concrete filter units, each having a capacity of 500,000 gallons. The pumping equipment consisted of two low duty raw water pumps for lifting the water from the suction well into the sedimentation basin and three compound condensing pumping engines. The boiler plant consisted of three 150 H.P. horizontal marine type fire tube boilers. Both the filter plant and the boiler and pumping plant were housed separately in brick buildings with wood trusses and galvanized roofing on wood sheathing. The average daily consumption of water by the city for the fiscal year ending May 30, 1915, was 1,766,610 gallons.

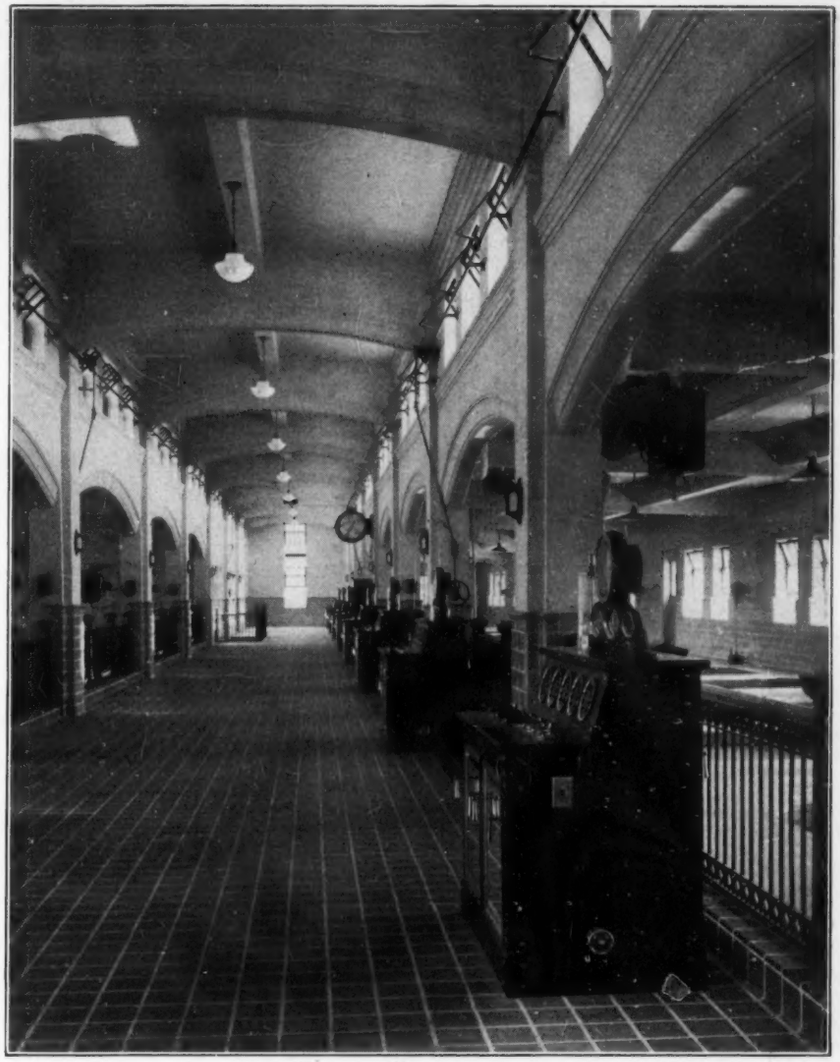
Within a short time after the city acquired ownership of the Raleigh Water Works, improvements were made to the system and plant, these improvements consisting of the construction of Lake Raleigh Dam and impounding reservoir with a capacity of 140,000,000 gallons; the construction of five additional filter units similar to those already installed, each having a capacity of 500,000 gallons per day; a new reinforced concrete sedimentation basin; extension of the raw water lines to the dam and Lake Raleigh for utilization of the head of water behind the dam, to increase the delivery capacity of the pipe line; the construction of another impounding reservoir, Lake Johnson, 1½ miles above Lake Raleigh, this reservoir having a capacity of approximately 400 million gallons; and an elevated steel water tank having a capacity of 600,000 gallons and located to the rear of St. Mary's College. The distribution system of the city was considerably enlarged and strengthened

at the same time.

The Walnut Creek water shed with its two impounding reservoirs, Lake Raleigh and Lake Johnson, consistently served the city until a prolonged drought in 1926 established the inadequacy of this water shed from the standpoint of a dependable supply over such periods of prolonged drought; and in 1927 the city established an auxiliary source of supply on Swift Creek at a point approximately seven miles southeast of the plant. At this point there existed Rand's Mill Dam, forming a lake of an appreciable capacity, this property being purchased by the city. Above Rand's Mill Dam there exists a water shed area of approximately 65 square miles. A pumping station was constructed by the city below the dam in which there were installed two motor-driven centrifugal pumps and between this pumping station and the water purification plant there was constructed 37,520 feet of 24-inch and 20-inch cast iron pipe line.

Facilities of Recent Date

Raleigh's water supply facilities just prior to the construction of the new Water Purification and Pumping Plant consisted of Lake Raleigh and Lake Johnson, impounding reservoirs on Walnut Creek watershed with a 30-inch cast iron raw water line 6,362 feet long from Lake Raleigh Dam to and connecting into 24-inch, 18-inch and 14-inch cast iron water lines each 6,672 feet long from their point of connection with the 30-inch line into the plant; the Rand's Mill Dam and Pumping Station on Swift Creek watershed with its above mentioned cast iron delivery line, a mechanical rapid sand type filter plant normally rated at 5,500,000 gallons per day; the above mentioned high and low duty pumping plant, and the two clear water reservoirs at the filter plant.



The Operating Gallery

(Note Five-Light Indicator Dials Revealing Valve Positions on Operating Tables; Also Note Indicator and Recorder on Each Table Showing Sand Expansion During Wash).

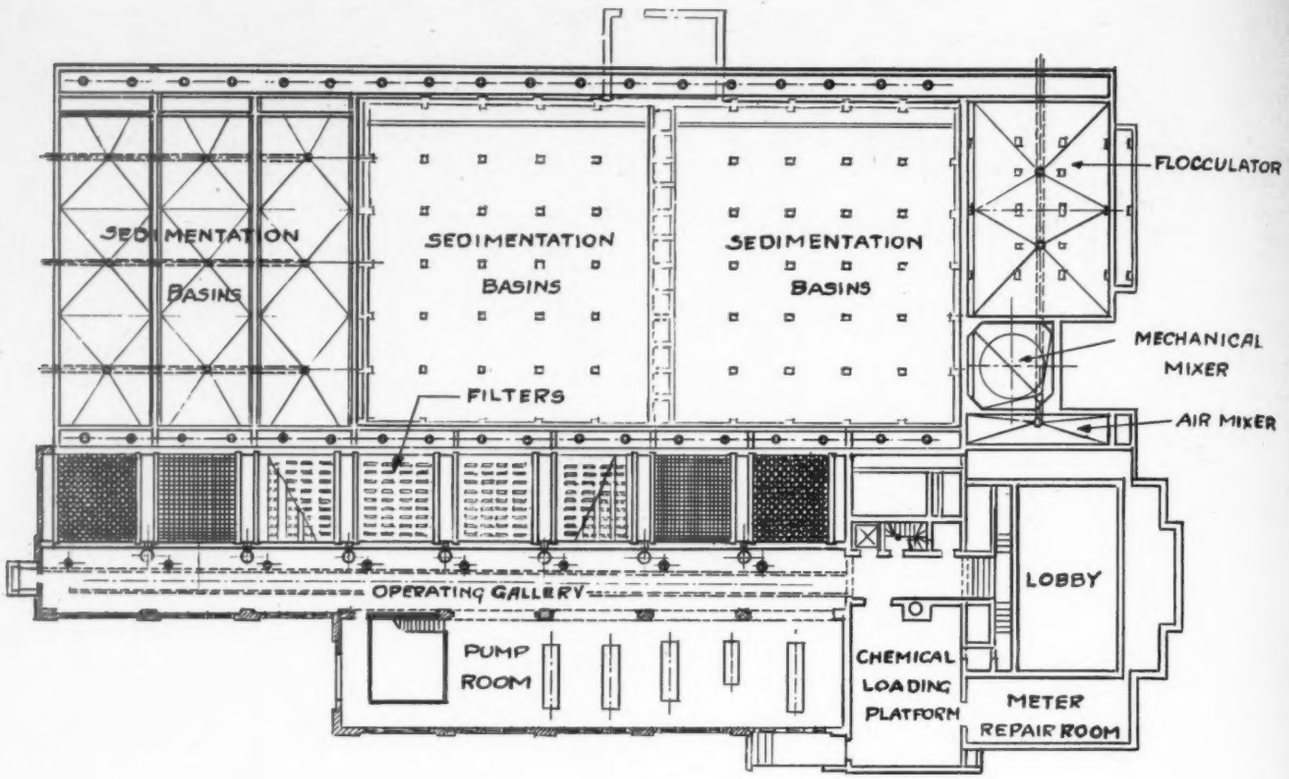
Raleigh's New Plant

Realizing the necessity for increased water supply facilities both from a standpoint of water purification and pumping facilities facing the city, due to the average demand on the plant being equal to the then existing capacity of the plant, the Mayor and Commissioners of the City of Raleigh in 1938 made application to the Federal Emergency Administration of Public Works for a grant for the construction of a new water purification and pumping plant, a new high duty pipe line to the western part of the city and an elevated steel water tank to serve the western part of the city, the total estimated cost of which was $700,000. Application for the grant (45 per cent of the $700,000) was approved by the Federal Emergency Administration of Public Works, plans and specifications were prepared and contracts for the first division of the work, which included the new high duty main to the western part of the city and elevated steel water tank, were awarded November 23, 1938. The contracts for the remainder of the work, which included the water purification and pumping plant, relocation of a county highway adjacent to the old plant and the construction of a relocated reinforced concrete bridge serving this highway and for a chain-link fence to enclose the entire property, were awarded June 28, 1939. All work under the entire project was completed May 31, 1940, at a total cost of approximately $11,000 under the estimated total cost.

Plant Location

The new plant was constructed on the site of the old plant after due consideration and thought was given as to the advisability of building an entirely new plant in a different location, but near the present location. It was determined that considerable money was to be saved by utilizing the existing reinforced concrete sedimentation basin and building a new plant around it. In addition this arrangement made it possible to utilize the two existing clear water reservoirs serving the old plant.

The plant is well located on Walnut Creek about one and one-half miles south of the principal business district of the city. The supplies from both Swift and Walnut Creek watersheds deliver to the plant at this location. If through some unprecedented growth of the city, the raw water supply from Walnut Creek and Swift Creek watersheds proves insufficient, Neuse River, having a watershed area of several hundred square miles



General Plan of the Plant

and passing six miles east of the city, can be utilized to supplement the Walnut Creek and Swift Creek supplies by constructing a pumping station at Neuse River and delivering water from this point to the Water Purification Plant as located.

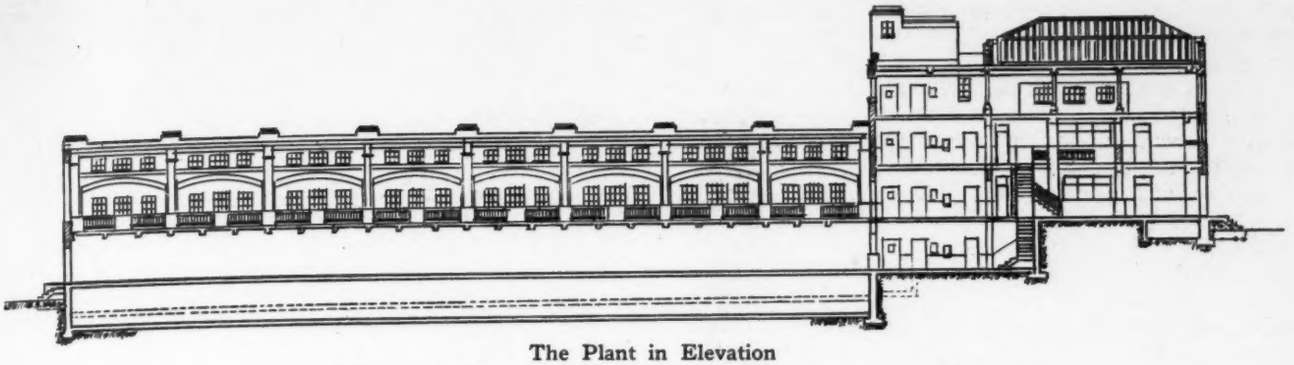
The Plant Proper

The water Purification plant and the High and Low Duty Pumping Stations are combined in one building. This was not the case with the old plant, the High and Low Duty Pumping Plant being separated from the Water Purification Plant by a distance of approximately 125 feet. The over-all dimensions of the New Water Purification and Pumping Plant are approximately 262 feet by 142 feet, of which area the Sedimentation Basins, 16 feet in depth, occupy approximately 210 feet by 77 feet.

The Water Purification Plant is of the Mechanical Rapid Sand Type having a normal capacity of slightly more than 8,000,000 G.P.D. There are eight filter units, each having a capacity of slightly in excess of 1,000,000 gallons per day, based on a rate of two gallons per minute per square foot of filter area. Some idea of the general plant layout may be gained by reference to the accompanying sketches of the plant in plan and profile. It will be noted that the eight filters are arranged in single bank with the sedimentation basins in tandem with the filters. The effective area of each filter is 18 feet by 20 feet. The filter wing of the building, including the filter operating floor, is approximately 185 feet long by 38 feet 9 inches wide. The High and Low Duty Pumping Room adjoins and is open to the Filter Operating Gallery and the Pipe Gallery and is approximately 118 feet 8 inches long by 26 feet 8 inches wide. (See picture on front cover of this issue.) The main entrance to the plant is through the entrance lobby of the Control Building at ground level.

Flanking the entrance lobby on the left and at ground level is a Meter Repair and Testing Room, approximately 40 feet long by 16 feet wide, and of the same dimensions on the right is the Compressor Room. At ground level and to the rear of the entrance lobby and ahead of the filter gallery and pump room are rooms for the plant shop, service entrance, toilet and locker room, service closet, service entry, elevator shaft and stairway. A service platform is provided between the meter repair and testing room and the pump room for the purpose of receiving chemicals hauled to the plant by truck. By elevator the chemicals are delivered to the Chemical Storage Room on the top floor. Below the meter repair and testing room there is located the fuel storage room, which holds sufficient coal to heat the plant an entire season. Below the ground floor toilet and locker room, service entry and loading platform is located the heating plant room, which is accessible from the outside, and also from the basement corridor leading to the pipe gallery. There is no basement under the plant shop room. Beneath the compressor room is located a mixing chamber, fitted with porous tubes for air-mixing of chemicals with the water. From the entrance lobby a flanking stairway on either side leads down to the pipe gallery and pump room floor level, access to the pipe gallery and pump room being through a corridor leading from this double stairway to the pipe gallery corridor. The pipe gallery and pump room are really one large room obstructed only by the columns supporting the filter operating floor gallery above.

At the entrance end of and above the pump room a mezzanine floor is placed on the same elevation as the filter operating gallery floor and accessible from the filter operating gallery floor, this mezzanine floor being housed in with glass partitions and is used for the main control switchboard. From the entrance lobby at ground level a main stairway leads to a flanking stairway on either side, which latter connect to a mez-



The Plant in Elevation
(*Chemical Storage, 3rd Floor—Laboratories, 2nd Floor*).

zanine balcony above, surrounding the greater part of the entrance lobby. In the space from the front row of columns in the lobby to the front wall of the main building is located a chemical laboratory and control room. This room is accessible from the mezzanine balcony on either side. To the right of the upper main lobby is located the chemical feed and flocculator and mechanical mixer control room having dimensions of approximately 40 feet by 16 feet. This chemical feed and control room is accessible from both the mezzanine balcony and the chemical laboratory. To the left of the upper main lobby is located the Plant Superintendent's Office, approximately 40 feet by 16 feet, one end of which is partitioned off for a file and record room. These rooms are also accessible from the mezzanine balcony and chemical laboratory. To the rear of the upper entrance lobby and on the same elevation as the mezzanine balcony are located a corridor extending from the mezzanine balcony to the filter and pump room wall. Off of this corridor are located toilet and locker rooms for the Plant Superintendent and employees, on the left hand side; and on the right hand side there is located a service closet, a stair well and an elevator shaft. On the same elevation as the mezzanine floor is located the chlorinator room. In the wall at the end of the corridor leading from the mezzanine floor is placed a look-out opening giving a view to the plant chemist from this floor level down on to the filter operating gallery.

The chemical storage room is located on the third (top) floor of the main part of the building and occupies an area of approximately 72 feet by 9 inches by 45 feet, or the main area of the control building except for the flanking wing on each side. This chemical storage room is off-set over the chemical feed room to accommodate the charging hoppers for the chemical feeders located below and the chemical storage room is accessible by means of both the stairway and the elevator which extend from the basement floor level to the chemical storage floor level with stops at each floor level. Chlorine cylinders are delivered from the service platform to the chlorinator room by means of the elevator.

To the right of the main control building and ahead of the sedimentation basins are located the Mechanical Mixers and Flocculators in their respective reinforced concrete basins.

Filter Effluent Conduit Somewhat Unique

Beneath the pipe gallery floor is located the filter effluent conduit. It extends the entire length of the pipe gallery and is divided into three compartments, each extending approximately the entire length of the pipe gallery. The compartment nearest the filters is a closed compartment, except for the effluent weir located at one end and below the pipe gallery floor. The other two compartments really amount to one compartment with a division wall extending from the main building end to within 4 feet six inches of the opposite end of the conduit.

The object in constructing this effluent conduit in this fashion was two-fold. First, for the purpose of maintaining a constant water level in the first compartment by means of the weir, to permit proper functioning of the filter rate controllers with varying heights of water in the other baffled compartment which is connected to the clear water reservoir. Secondly, to establish a time travel interval of the water after the finishing chemicals have been applied before the water reaches the clear water reservoirs. Adjacent to the above described clear water flume is located a pump suction well 7 feet wide and extending the entire length of the high duty pump room. This pump suction well is connected directly with the clear water reservoirs, and the high duty pumps and the wash water pumps take their suctions directly from this pump suction well. A safety by-pass gate is arranged for discharging directly into this pump suction well from the filter effluent conduit, if for any reason the supply to the pump suction well is cut off from the clear water reservoirs.

At the rear end of the pump room is located the raw water pump room with a floor elevation 12 feet below that of the high duty pump room floor with access to same by means of a stair-way between the two pump room floor levels.

Filter Waste Conduit Serves Dual Purpose

Instead of installing the filter waste discharge main exposed to view in the pipe gallery in the conventional manner, a waste discharge conduit 4 feet by 6 inches wide and 6 feet by 3 inches deep was constructed *beneath* the bottom of the filters near the front of same and adjacent to the clear water conduit beneath the pipe gallery floor. This waste conduit extends the entire length of the bank of eight filters and each filter waste and rewash line discharges into this conduit. This conduit not only serves the purpose of eliminating a large cumbersome appearing pipe line in the pipe gallery, but also serves the purpose of giving access to the false bottom of the filters through flanged access manholes in the main bottoms of the filters, which also constitute the roof of the waste conduit. The end of the waste conduit is connected into the nearest manhole of the exterior underground waste piping system.

As above mentioned, the existing sedimentation basin was incorporated in the sedimentation basin for the new

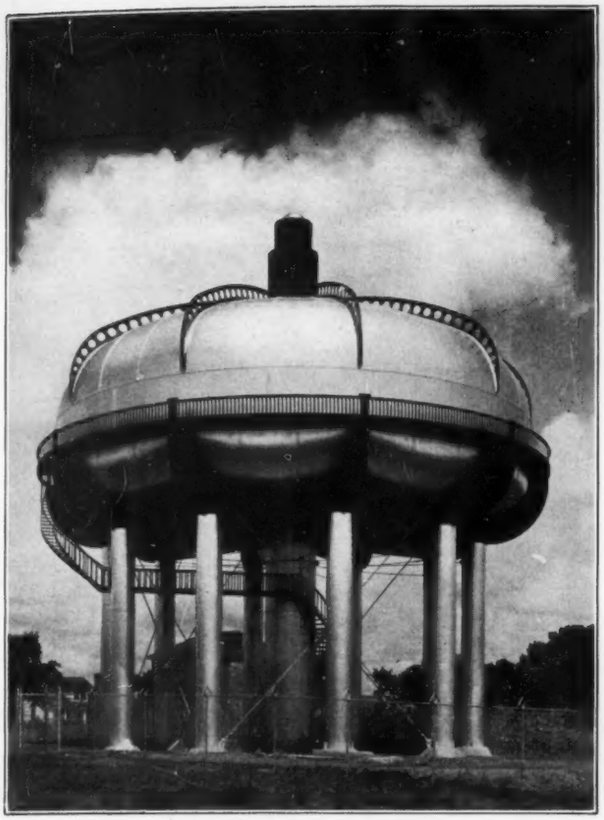
plant. In order to maintain the proper differential between the water level in the new sedimentation basins and the clear well for proper functioning of the rate controllers it was necessary, in view of a fixed high water elevation of the two clear water reservoirs which were retained, to raise the walls of the old sedimentation basins 2 feet, 8 inches; and five of the filter units, each rated at 1,000,000 gallons per day, were arranged tandem to the two old sedimentation basin compartments. The central mixing chamber in the old sedimentation basin was abandoned, a new treated water conduit was provided across the rear of the old sedimentation basins and the flow through the old sedimentation basins was from the rear to the front and thence through a distribution conduit to the filters. Three individual new sedimentation basin units were added, each being tandem to its respective filter. The entire sedimentation basin, comprising the salvaged old basin and the new addition, is designed to provide a retention period of four hours at a plant capacity of 8,000,000 G. P. D. The settled water conduit between the sedimentation basin and the filters is so arranged that either compartment of the old sedimentation basin or either unit of the new sedimentation basin may be cut out of service for cleaning while the remaining sedimentation units serve the filters.

Mixing and Flocculation

The mixing units of the new plant comprise the flash air mixing compartment beneath the compressor room, as hereinbefore referred to; a medium speed mechanical vertical paddle type mixer and a slow "flocculator" of the horizontal paddle type. These mixing features are so designed and piped that either one may serve alone, or any combination of mixing facilities may be utilized. Air mix is also provided in the plant because at certain seasons of the year it has been found beneficial to utilize such type of mixing. The air mixing equipment consists of two centrifugal type compressors, each connected into a header to which is attached porous tubes. The mechanical mixer consists of a vertical shaft with horizontal arms at 90 degrees to each other from which are suspended metal paddles. The mixer is driven by a universal geared motor having eight speeds. The flocculator is of the Dorr type, consisting of three horizontal shafts on which are mounted horizontal paddles on radial arms attached to the shaft. The three shafts of the flocculator are connected together

The Pump Room

(Note Water Elevation Gauges on Rear Panel for Coagulation Basin, Clear Water Reservoir and Elevated Tank. Picture Was Made from the Pipe Gallery).



The New Elevated Tank
(Photo Courtesy Chicago Bridge and Iron Co.)

by chain and the entire mechanism is driven by a four-speed geared motor. The flocculator discharges into a settled water conduit extending the entire length of the sedimentation basins.

Raw Water Flow Control

The raw water supply to the plant is provided through closed cast iron pipe lines connecting into the dam at Lake Raleigh. The elevation of the spillway of Lake Raleigh Dam is 281.19. The water level elevation in the sedimentation basins is 265.90. This static head of a little more than 15 feet is sufficient to deliver 5,000,000 gallons per day by gravity from Lake Raleigh.

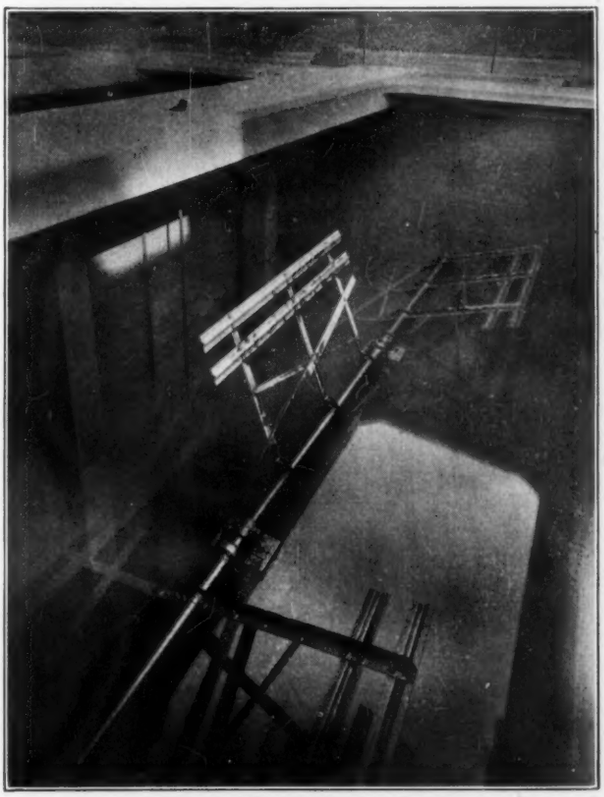
The 14-inch, 16-inch and 24-inch raw water pipe lines from Lake Raleigh are connected near the plant into the 30-inch line which extends through the Venturi meter to a point of connection with the raw water pipe line from Rand's Mill. This point of connection is on the exterior of the pump room and from this junction point the line is reduced to 24 inches and is extended to the air mixing flume through a float controlled regulating gate valve. Just before the junction of this line with the Rand's Mill line, shunt suction and discharge connections are made from the line to the two motor-driven raw water pumps in the pump room, a check valve being placed on the 30-inch line between these shunt suction and discharge connections.

The raw water pumps are of the variable speed type with eleven speed points on the automatic master controller actuated by the water level in the sedimentation basin. It is thus seen that when the demand through the plant exceeds the 5,000,000 G.P.D. gravity capacity of the pipe lines between Lake Raleigh and the plant, one of these booster pumps will automatically be thrown into service.

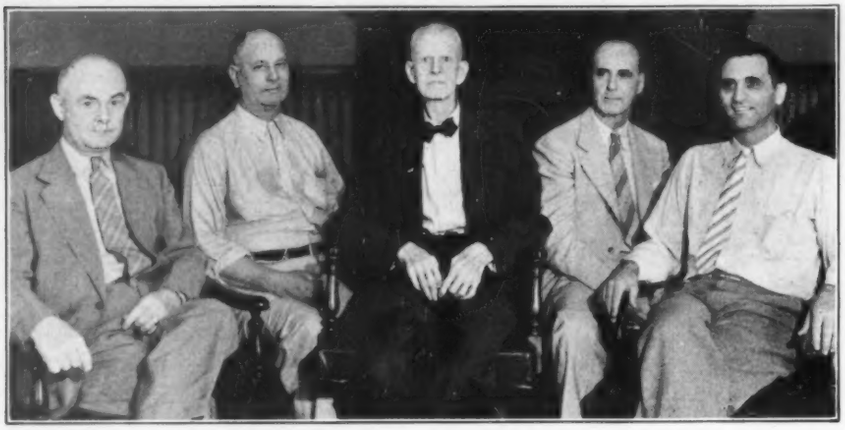
The capacity of one raw water pump is 10,500,000 G.P.D., that of the other 8,000,000 G.P.D., and it has been demonstrated that the raw water pipe lines will deliver, under this condition, at least the full capacity of the larger pump. From the entrance compartment of the air mixing chamber, the raw water may flow through either the air mixing compartment, the rapid mechanical mixing compartment or the flocculator, or through any combination of these units. It then enters the settled water flume across the rear of the sedimentation basins. From this settled water flume the flow is a straight line across the sedimentation basins to the filters, a stilling wall with distributing parts across the influent end making for uniform displacement.

Control of Filtered Water Flow

The filtered water discharges through automatic rate controllers of the Simplex type into a clear water conduit beneath the pipe gallery floor. This clear water conduit is connected to the two clear water reservoirs by means of a 36-inch cast iron pipe line. From the clear water reservoirs the water is delivered to the pump suction well beneath the pump room floor through a 36-inch pipe line. The depth of the pump well is equal to that of the clear water reservoirs. From the pump well filtered water is delivered to the city distribution system through three high duty force mains, one of these being 14 inches in diameter and the other two being 16 inches in diameter. These force mains connect into the distribution system at widely different points and they are taken from two separate and distinct sectionalized pump headers, so arranged that the maximum demands on the distribution system can be supplied by one or more high duty pumping units, in the event of a rupture in either main or pump discharge header. Water is measured in each high duty main by means of a Venturi meter. One of these 16-inch high duty mains was installed from the plant to the western part of the city under the new plant construc-



One of the Flocculator Chambers



Executive and Operating Personnel

(From Left)—Roy L. Williamson, Director of Public Works; Jim Horton, Plant Mechanical and Electrical Supt.; Ernest B. Bain, Supt. of Water, in Honor of Whom the Plant Has Been Named, and in recognition of a 43-Year Service record; Willis A. Holding, Chemist and Supt. of Filtration; E. M. Johnson, Asst. Supt. of Water Works.

tion program and included in this construction program was, also, a 750,000 Elevated Steel Water Tank of interesting design here pictured.

High Duty Pumping Equipment

The High Duty Pumping Equipment installed in the new plant consists of two motor-driven centrifugal pumps brought over from the old plant, each having a capacity of 3,500 gallons per minute against a pumping head of 300 feet; each of these units consists of two single stage pumps connected in series. These pumps were manufactured by Morris Machine Works and the motors are General Electric wound rotor or slip ring type. In addition to the above mentioned pumps there are installed in the new plant a new motor-driven high duty pump having a capacity of 5,000 gallons per minute and a stand-by gasoline engine-driven pump having a capacity of 3,500 gallons per minute, each unit designed to pump against a head of 300 feet. These two pumps each consist of two single stage centrifugal pumps connected in series and they were manufactured by DeLaval Steam Turbine Co. The motor driving the 5,000 g.p.m. pump is manufactured by General Electric Co. and is rated at 500 H.P. and is of the synchronous type. A Sterling engine drives the 3,500 g.p.m. pump. Both of these pumps are designed to deliver their rated capacity at 1,200 R.P.M.

Main Switchboard and Control Panel

The switchboard which constitutes the main incoming line panel, distribution panels and motor control panels is located in the switchboard room above the north end of the pump room and connecting with the filter operating floor. The switchboard is made up as follows, counting from the left (see cut.):

Panel No. 1, Incoming Line.

Panel No. 2, Control for the 500 H.P. High Duty Pump Motor.

Panel No. 3, Control for Future 500 H.P. High Duty Pump Motor.

Panel N. 4, Control for a 300 H.P. High Duty Pump Motor.

Panel No. 5, Control for a 300 H.P. High Duty Pump Motor.

Panel No. 6, Control for a 150 H.P. Wash Water Pump Motor.

Panel No. 7, Control for a 100 H.P. Raw Water Pump motor.

Panel No. 8, Control for a 60 H.P. Raw Water Pump Motor.

Panel No. 9, Miscellaneous Distribution.

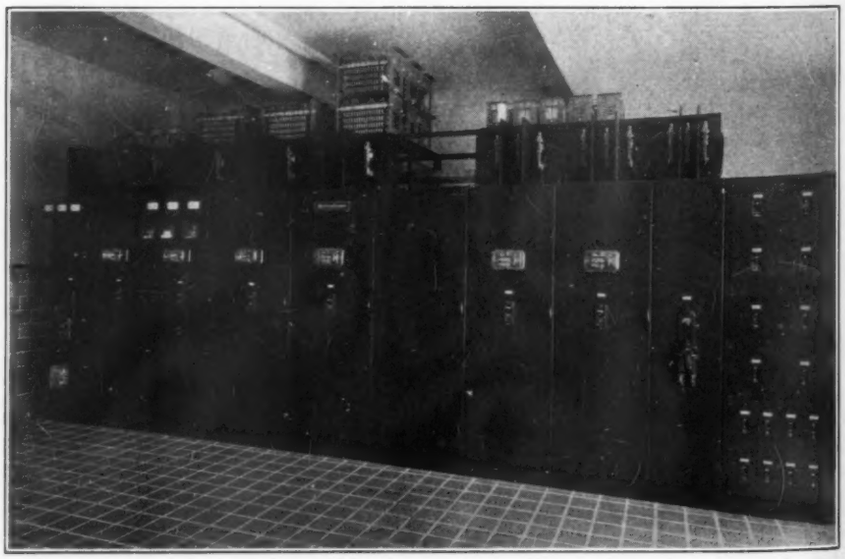
Each of the high and low duty pumps may be started and stopped from the main switchboard or they may be started and stopped by means of the push button switches located on the individual pumping units. The switchboard is of the dead front type and is constructed of ⅛-inch thick formed stretcher leveled steel, the height of the panels being 76 inches.

Wash Water Facilities

A motor-driven centrifugal pump having a capacity of 6,000 gallons per minute is utilized for washing the filters. This pump operates at a speed of 1,200 R.P.M. and the operating head on same is variable up to 40 feet. This pump takes suction from the pump suction well beneath the pump room floor and discharges through a rate controller which can be adjusted from a table on the filter operating floor for any desired wash water rise in the filters up to a rate of 36 inches per minute. A large illuminated gauge 24 inches in diameter is mounted above the filter operating floor, in clear view of the operator, which indicates the rate at which the filters are being washed and enables the operator to set the desired rate of wash.

The Filters and Appurtenances

Each of the eight filters is equipped with a Wheeler type bottom. Such consists of a false filter bottom constructed of reinforced concrete supported on concrete piers 23 inches above the structural floor of the filter tub. This false bottom consists of a series of depressions of inverted pyramidal forms cast into the concrete on spacings of 12-inch center to center and each



Main Switch Board and Control Panels

Yesterday and Today

(Comparing the Chemist's Office and Laboratory in the Old Plant With That of the New. The Sampling Table Is Seen on the Left Between the Two Cabinets. The roomy office of the Chemist Is Beyond the Far Door.)

connecting with the pressure chamber beneath the false floor by means of a porcelain thimble extending downward through the concrete of the false bottom below the apex of the depression. In each pyramidal depression five large porcelain spheres and nine smaller ones are placed in the following order: One 3-inch sphere in the bottom of the depression; four 3-inch spheres above the bottom sphere and fitting accurately to the sides of the depression and among themselves; and eight 1¼-inch spheres fitting into the interstices between the four large spheres and the sides of the corners of the depression. One 1⅜-inch sphere is fitted into the central space between the large spheres Around these spheres selected gravel is handpacked to fill the depressions level with the filter floor.

On the under-drainage system, above described, filter gravel is placed in four layers, each 3 inches thick to a depth of 12 inches, this gravel being of sizes to be retained on screens having circular openings of ½-inch, ⅜-inch, 3/16-inch and 1/12-inch, respectively. Filter sand is placed on the gravel bed to a total depth of 27 inches. The sand is of an effective size of not less than 0.35 m.m. nor more than 0.42 m.m. with a uniformity coefficient of not more than 1.65. Each filter is equipped with three cast iron waste wash water collecting gutters or troughs which discharge into a gullet constructed along side of the filter.

In connection with each filter there is installed in the 10-inch effluent connection a rate of flow controller of the Venturi direct-acting type. In front of each filter there is installed a piano-type operating table of black ebony asbestos having a satin finish (see view of filter operating floor.) These operating tables are equipped with two removable front doors, the frames of which are cast bronze, chromium plated and fitted with bevel plate glass mirrors. Two rear removable type doors provided with screen panels of bronze wire provide access to each operating table also from the rear. All trimmings for the operating tables are chromium plated. On each filter operating table there is installed a combined indicating and recording loss of head and rate of flow gauge; an indicating Simplex Sand Expander gauge; a vertical cylinder-type sampler with a reflector-type tubular light and the full complement of filter operating levers connecting through 4-way valves installed in the pressure header inside of the operating table. All gauges and operating levers are trimmed in chromium plate.

It is interesting to note that, insofar as the writer is aware, these tables are the first to be equipped with indicating lights showing the degree of opening of every filter valve, as well as the open and shut indication of the valve. On each table there are five of these indicators and such an installation eliminates all of the usual (frequently troublesome) indicator cords and sheaves between the hydraulic valve cylinders and the tables. They accurately indicate, by means of these small lights, (around the watch so to speak), eight positions of the gate between full opening and full closing of the gate. This design of indicators has proven extremely satisfactory.

Sample Table

A sample table of the same material and design as that of the filter operating tables is installed in the chemical laboratory and this table is fitted with five sampling devices so that samples can be taken from the following points:

1. Raw Water, taken from the raw water ahead of any application of chemicals.
2. Treated Water, taken from the supply flume to the sedimentation basins at the outlet end of the mixing equipment.
3. Settled Water, taken from the outlet flume of the sedimentation basins.
4. Filtered Water, taken from the flume of the primary clear well ahead of the final application of chlorine or pH correction chemicals.
5. Finished Water, taken from the high duty suction well below the pump room.

Each of the five sample devices is actuated by means of a motor-driven pump of the self-priming turbine type, having a capacity of 1 g.p.m. at 30 feet total head.

The Laboratory

Without listing the equipment installed in the Laboratory, suffice it to say that the plant has a laboratory of sufficient size which is fully equipped with modern steel laboratory furniture and all equipment required

in the most modern water purification plant, as may be attested to by the accompanying photograph of the chemical laboratory. A recent addition has been the Enslow Continuous Stability Indicator for determining corrosivity of the water and proper corrective treatment.

Chemical Feed Machines

In the Chemical Feed Room are installed five Dry Chemical Feed Machines of the Wallace and Tiernan MOF type. Each of these chemical feed machines is fitted with a large diameter extended hopper connecting the machine hopper with the individual screened floor hoppers immediately above, set in the floor of the chemical feed bay of the chemical storage room. This arrangement provides additional hopper capacity to each machine and eliminates dust nuisance between the machine and the hopper in the chemical feed machine room. Viewing the battery of machines (see cut), No. 1 is for feeding alum, No. 2 is for primary lime application, No. 3 is for secondary lime application, No. 4 is for activated carbon and No. 5 is considered a spare machine and is so piped that it may be used for feeding alum, lime or activated carbon. As above noted, the chemical feed room opens into the chemical laboratory and is easily accessible to the Chief Chemist. Raw Water Flow Indicators are located in the chemical feed room, one for the Walnut Creek supply and the other for the auxiliary Rand's Mill supply.

Chlorinators

Adjacent to the chemical feed room and accessible from the mezzanine balcony is located the Chlorinator Room in which are installed three Chlorinators of the Wallace and Tiernan MSV-M type. One of these Chlorinators, having a capacity of 100 pounds is used as a spare machine. The other two machines, each having a capacity of 40 pounds, are used for pre-chlorination and the other for post-chlorination. All three machines are piped to a rubber distribution header mounted on a panel so that any machine may be used for pre- or post-chlorination. Each chlorinator is mounted on a flush floor type Toledo Indicating and Recording Scale. The chlorinator room is provided with an emergency gas relief discharge in the event of accidental rupture of any gas connection.

Reservoir Depth Gauges and Tank Gauge

In the rear of the high duty pump room there is installed a gauge board of the same material and finish as the main switchboard and on which are mounted three gauges, each 24 inches in diameter. The gauge on the left indicates the depth of the water in the elliptical clear water reservoir; the gauge on the right indicates the depth of water in the rectangular clear water reservoir and the center gauge indicates and records the depth of water in the new 750,000 gallon elevated tank constructed under this program and located approximately three miles from the plant. This equipment was supplied by the Bristol Company.

Heating and Plumbing System

The entire building is heated by a stoker-fired boiler located in the basement boiler room and the system is the low pressure steam type. The boiler has a capacity of 6,600 square feet E.D.R., exclusive of piping load and supplies steam to the unit heaters in the filter room, pipe gallery and pump room and to cast iron radiators elsewhere in the plant. The boiler is fired with an automatic stoker with an extended screw taking coal directly from the coal storage compartment. The hot water supply to the chemical laboratory, toilet rooms and showers is by means of an integral type oil burner, equipped hot water storage tank, located in the basement boiler room near the main heating boiler and which functions entirely automatically. There is located in the compressor room a drinking water refrigerating machine, which supplies cold drinking water to drinking founts located at various parts of the building. The cooling mechanism operates automatically, maintaining the water at a pre-determined temperature.

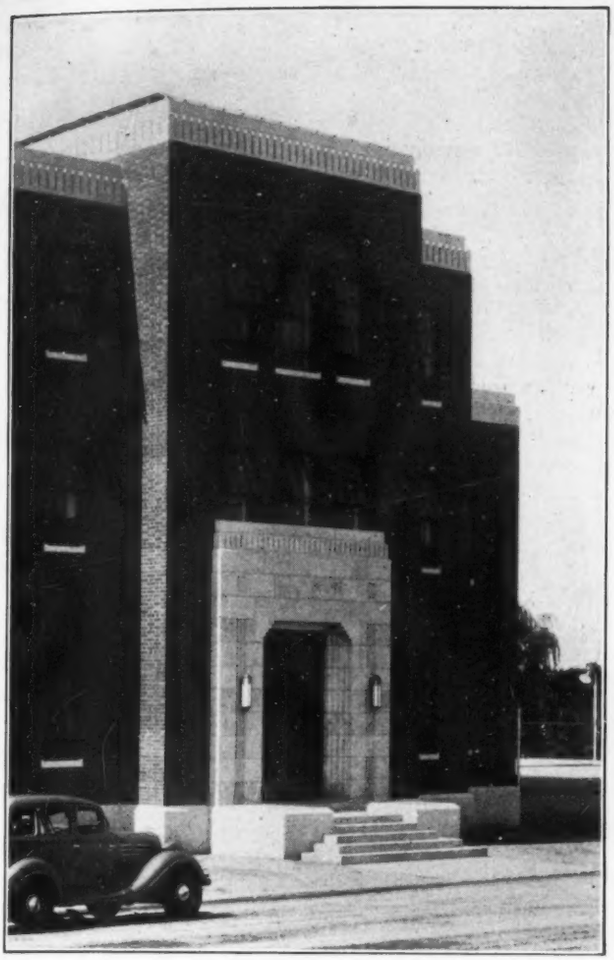
A completely equipped toilet room with lockers is provided on the third floor for use of the plant Chemist; on the second floor, for use of the Mechanical Plant Superintendent; and in the basement boiler room for the use of the colored plant employees. On each floor there is also located a service room in which is installed a sink and which also houses floor mops, brooms and other equipment required for keeping the plant in a neat and clean condition.

Architectural Treatment

The design of the Building, which was constructed of concrete, brick and steel, is as indicated by the photo-

Chemical Feeder Room

(Designed With Emphasis on Dust Elimination. Note Flow Indicating and Recording Instruments Located in This Room. Through Door to Left Are the Chlorinators).



The Plant Entrance

[Through Which We Entered to Find an Impressive Interior—and Through Which We Left All Too Soon.—Ed.]

graphs accompanying this article. The floors of the entrance lobby, both main stairways and vestibules, filter operating floor, switchboard room floor, high and low duty pump room floor are 6 inch red quarry tile laid on concrete with ½ inch wide mortar joints. The floors in all toilet and locker rooms, except that in the basement and the chemical laboratory, are white ceramic tile. The floors in the meter testing room, compressor room, shop, chemical feed room, chlorinator room and chemical storage rooms are monolithic concrete troweled to a smooth finish and painted. The floors in the plant office and record and file room are of concrete covered with battleship linoleum. All interior walls of the building have a buff-colored glazed brick-tile wainscoting to a height of 4 feet, except walls of the chemical laboratory and toilet rooms, which have ceramic tile wainscoting and the walls of the compressor room, meter testing room, heating plant room, stairwell and elevator shaft, shop, chemical feed room and the chemical storage room, which are painted brick. Walls and ceilings in the entrance lobby, second floor foyer, office, record room and chemical laboratory are of white finish plaster and painted. Walls in all other parts of the building above wainscoting are finished with buff colored Caenstone plaster marked in white to simulate stone blocks. The ornamental arches over the corridors, filter operating gallery and between the columns adjacent to the filters and the pump room are also of Caenstone plaster similarly marked. The roofs over the filters, filter operating gallery and the pump room are concrete slabs on which is laid composition roofing, and the undersides of the slabs forming the ceilings of these rooms are finished smooth and painted a light buff color to harmonize with the Caenstone plaster. Walls of the filter bay surrounding the filter tubs are faced with buff colored glazed brick from the glazed tile wainscoting to the ceiling. The top slabs around the filter tubs are finished smooth and are painted with green "Ramuc" Enamel. Sash and miscellaneous iron work in the plant is painted in gloss black which also includes the ornamental railing which is topped with a birch handrail in natural finish. All cast-iron pipe in the pump room and pipe gallery is painted a gloss battleship gray. All pumping equipment is painted a gloss elephant gray.

The front entrance of the building is of cast stone and front entrance steps are of North Carolina Granite. Window sills and copings, chimney cap, etc., are of cast stone.

New High Duty Pipe Line and Elevated Tank

There was included in the new plant construction program a New High Duty Main extending from the duplicate pump headers in the plant to the western part of the city to a location of the New Elevated Steel Water Tank at Chamberlain Street and Everett Avenue. This line included 14,962 feet of 16 inch, 1,834 feet of 12 inch, 120 feet of 8 inch and 552 feet of 6 inch Cast Iron Class "C" Pipe, with gate valves and fire hydrants. When this new supply main was connected into the distribution system it greatly improved low pressure conditions existing in the western section of the city during periods of maximum water consumption.

New Elevated Tank

The new elevated steel water tank was constructed at Chamberlain Street and Everett Avenue, the western terminus of the new 16 inch High Duty Main, this tank having a capacity of 750,000 gallons and being of the shallow depth type. Height of water to the overflow in the tank above the foundations is 60.93 feet and this overflow elevation is the same as the overflow elevation on the old 600,000 gallon elevated tank located back of St. Mary's College, which has an over-flow height above the top of the foundations of 129.5 feet. The New Tank is 74 feet 6 inches in diameter and has a water depth of 25 feet. It is of Colonial design (see cut) and is supported on ten cylindrical columns 44 inches in diameter and a central riser pipe 8 feet in diameter around which is placed a spiral stairway connecting to a horizontal and spiral section of walkway leading to the balcony surrounding the tank. Except for the supporting columns the tank is of riveted construction and is lined inside with Bitumastic Enamel.

Personnel

This project was initiated under the City Administration comprising George A. Iseley, Mayor; Roy L. Williamson, Commissioner of Public Works; and T. K. Fountain, Commissioner of Public Safety. The project was placed under construction and completed by the succeeding administration comprising Graham H. Andrews, Mayor; Roy L. Williamson, Commissioner of Public Works; and Robert C. Powell, Commissioner of Public Safety, J. E. Sawyer being City Clerk to both administrations. The new "Ernest Bain Water Plant" was officially dedicated in honor of Mr. E. B. Bain, Superintendent of the Water Department, who has served so faithfully in this position since the Raleigh Water Plant was constructed and operated by the origi-

nal Wake Water Company. The writer was Designing and Consulting Engineer for the project. Supervision of construction of the entire project was extremely well handled by the City's Engineering Department under the very able and businesslike direction of Public Works Commissioner, Roy L. Williamson, who is well known for his engineering ability. The responsibility for proper treatment of the water is very ably taken care of by Mr. Willis Holding, City Chemist, in charge of this feature of the operation of the plant. The responsibility for the proper functioning of the Mechanical and Electrical Equipment in the plant is taken care of by Mr. Jim Horton, who is in charge of this feature of the operation. Mr. E. M. Johnson very ably fulfills the position of Assistant Superintendent of the Water Department.

Contractors and Sub-Contractors

The General Contract for the new plant was executed by A. H. Guion and Company, of Charlotte, N. C. Roberts Filter Manufacturing Company, of Darby, Pennsylvania, subcontracted the furnishing and installation of all Filter Equipment and Interior Filter Piping from the General Contractor. Plumbing and Heating work in the building was contracted to Biemann and Rowell, Raleigh, N. C. Relocation and Construction of the County Highway and the new Bridge across Walnut Creek was contracted for by F. D. Cline, of Raleigh, N. C. The new 16 inch High Duty Force Main and Piping and Valves at the new Tank was contracted for by V. B. Higgins Company, of Greensboro, N. C.

A list of those furnishing principal materials and/or equipment entering into or forming a part of the project, under the General Contract, is as follows:

Cast Iron Pipe—Glamorgan Pipe and Foundry Co., Lynchburg, Va.

Exterior Valves—Rensselaer Valve Co., Troy, N. Y.

Filter Gauges, Rate Controllers, Venturi Meters, Sand Expansion—Simplex Valve and Meter Co., Philadelphia.

Dry Chemical Feed Machines and Chlorinators—Wallace and Tiernan, Inc., Newark, N. J.

Pumping Equipment salvaged from the Old Plant—Morris Machine Works and General Electric Motors.

New Pumping Equipment—De Laval Steam Turbine Co., Trenton, N. J., with Westinghouse Motors and Sterling Engine.

Switchboard and Control Panels—Westinghouse Electric and Mfg. Co.

Pump Room Crane—Maris Brothers, Philadelphia.

Elevator—Monarch Elevator and Machine Co., Greensboro, N. C.

Heating Equipment—Dillon Supply Co., Raleigh, N. C.

Filter Equipment, Interior Piping, Air and Mechanical Mixing Equipment—Roberts Filter Mfg. Co., Darby, Pennsylvania.

Flocculator Equipment—The Dorr Company, New York, N. Y.

Sedimentation Basin Valves and Sluice Gates, Interior Valves, Including Filter Valves—The Chapman Valve Mfg Co., Indian Orchard, Mass.

Tile Work—Atlantic Marble and Tile Company, Greensboro, N. C.

Filter Sand and Gravel—Southern Silica Mining and Mfg. Co., Columbia, South Carolina.

Chemical Hoist in Chemical Storage Room—The American Monorail Company, Cleveland, Ohio.

Building Brick—Cherokee Brick Company, Sanford, N. C.

Cast Stone—Arnold Stone Company, Greensboro, N. C.

Roofing and Sheet Metal Work—Avrett Roofing and Heating Company, Charlotte, N. C.

Reinforcing Steel—The Southern G. F. Company, Greensboro, N. C.

Plaster Work and Painting—C. W. Kirkland, Charlotte, N. C.

Electrical Work—Mill and Marine Electric Company, Inc., Gastonia, N. C.

Cement—Signal Mountain and Penn Dixie brands, furnished by J. B. Hunt and Son, Raleigh, N. C.

Crushed Stone Concrete Aggregate—Raleigh Granite Company, Raleigh, N. C.

Laboratory Furniture and Fixtures—Kewaunee Mfg. Co., Adrian, Mich.

Structural Steel—Dietrich Bros., Inc., Baltimore, Md.

Elevated Steel Tank—Chicago Bridge and Iron Co., Chicago.

Water Level Indicator and Recorder—The Bristol Co., Waterbury, Conn.

Chain-Link Fencing—Anchor Post Fence Co., Baltimore, Md.

RICHARD D. HOAK APPOINTED FELLOW OF MELLON INSTITUTE

Succeeds Dr. W. W. Hodge

Richard D. Hoak has been appointed a fellow of the Mellon Institute of Industrial Research to carry forward the work begun by Dr. W. W. Hodge in acid recovery from iron and steel mill wastes.

This fellowship is maintained by the American Iron & Steel Institute, looking toward stream pollution abatement by reducing the acid and iron in steel mill wastes reaching streams.

Dr. Hodge has been on leave from the University of West Virginia, which was granted for the purpose of getting the work under way. He will return to the universtiy but will continue to serve the institute in an advisory capacity.

Mr. Hoak was until recently a district engineer with the Pennsylvania State Department of Health.

LAYING FIRE SUPPLY MAINS
(Illustrated Specifications in Detail)

The Inspection Department of Associated Factory Mutual Fire Insurance Companies has recently published an 8 page (8x11) brochure of illustrated and adequately detailed specifications covering the correct laying of cast-iron fire supply mains.

These specifications have been developed from the Standard Specifications for Laying Cast Iron Pipe of the A.W.W.A., with such changes as are necessary to adapt them to Factory Mutual's standards. The sketches employed to illustrate the specifications add to their value.

We understand these useful ready reference specifications are available merely for the cost of a requesting letter to "Factory Mutual"—(Inspection Dept.)—184 High Street, Boston, Mass.

CALIF. SEWAGE WORKS ASSOCIATION ENDS SUCCESSFUL YEAR

With the meeting held in San Diego last month the California Sewage Works Association brought to a close what is thought to be its most successful year.

The following officers will steer the ship during the next year:

President—Harold F. Gray.

1st Vice Pres.—Fred D. Banlns.

2nd Vice Pres.—Carl M. Hoskinson.

Secy.-Treas.—Wm. T. Ingram.

A. L. Fricke, Jr., and Chas. Getman Hyde were continued as representative on the Board of Control.

SEWAGE WORKS FEDERATION'S FIRST CONVENTION

Proves in Every Respect a Success With Better Than 600 Attending

THE first National Convention of the Federation of Sewage Works Associations held in Chicago, Oct. 3-5, proved to be the success which many had predicted for this first venture of holding a Sewerage Convention of national scope patterned along lines of the annual Water Works Convention.

In quality this convention surpassed quantity, although the official paid registrations ran to 556 and the attendance something more than 600. One of the most conspicuous and somewhat surprising features of this initial Sewerage Convention was the number and excellence of manufacturers' exhibits, with every foot of available space taken by 55 exhibitors and an overflow onto the mezzanine floor of the Hotel Sherman, where the convention was held.

Although the first convention of the Federation was held in conjunction with the annual meeting of the Central States Sewage Works Association, it was interesting and indicative to note from the printed registration lists that not more than half of those attending came from the nearby Central States territory, and further examination revealed the presence of men from all sections of the country, with a goodly number from the Pacific Coast.

Important Business Session

The Technical Sessions were well attended, but none better so than the Business Sessions, occupying two hours on the closing day. At this session Chairman C. A. Emerson presented a review of the more important and consequential parts of the proposed Constitution and By-laws, which when accepted by member associations in the Sewage Works Federation is intended to bring about a stronger organization of sewage works operators and engineers, patterned very much along the lines of the American Water Works Association as to its aims and objects. Chairman Emerson explained the necessity of charging a membership fee of $3.50 for all except operators of the smaller plants and any others holding positions in the lower salary brackets. For this group the membership fees has been set at $2.00, representing only a 50 cent increase above the $1.50 dues which have heretofore been in force. The $2.00 fee includes the cost of the Sewage Works Journal and the 50 cents extra constitutes a contribution to the general expense of running the proposed Federation headed by a full time secretary. The by-law explicitly states that the reduced fee in no wise affects a member's standing or his rights in the Federation. Those who shall be eligible to the $2.00 membership will be determined by the officers of each member association, and any number of such memberships up to 50 per cent of the total membership of the member association is permitted. This matter is patterned very much after the reduced fee Affiliate Membership in the A. W. W. A. except that such members have no voting privilege and do not receive all copies of the A. W. W. A. Journal.

Chas. A. Emerson, Jr.
New York, N. Y.
(Chairman of the Board)

Harry E. Moses
Harrisburg, Pa.
(Federation Secy.-Treas.)

C. C. Larson
Springfield, Ill.
(New Chairman, C.S.S.W.A.)

W. H. Wisely
Springfield, Ill.
(Secy.-Treas., C.S.S.W.A.)

The proposed constitution calls for the election of a president and vice-president each year, neither being eligible for re-election; a Board of Control comprising one elected member for a three-year term from each member association, and no director being eligible to succeed himself on the Board. Heretofore Board members have been serving many years without change and the present chairman has served since the inception of the Federation.

Mr. Emerson explained the need for a more closely knit Federation in order that working committees might be set up from the membership at large, looking toward the establishment of standards in practice and equipment which are sorely needed now in the sewerage field as they were earlier in the water supply field. In similar manner an organization of national breadth and scope could be expected to effectively promote sewage and waste treatment, derive more adequate recognition of sewage works operators, and strengthen their financial position and status in municipal enterprise.

Many men took the floor in discussing the pros and cons of forming a national organization. Strangely enough, not a voice was heard concerning the earlier fears expressed by a few who felt that manufacturer cooperation would spell equipment purveyor domination in the proposed affiliation between the Water and Sewage Works Mfrs. Association and the Federation on a basis similar to that now existing in the A. W. W. A. We believe this development was largely due to experiences gained in manufacturer relationships in developing and arranging the excellent exhibit of the first convention and a worth while net profit of something more than $1,000 accrued to the Federation after settling all convention bills, thanks to the management of "Bill" Orchard as chairman of the Committee on "Ways and Means."

Perhaps the first analysis of the potential advantages of a stronger Federation, as outlined in the Constitution, was that presented by Mr. Langdon Pearse of the Chicago Sanitary District. He discussed the potential worth of national conventions to members; the value of manufacturer support in producing high grade convention exhibits and their advertising support, making for a better and a self-supporting Journal;

the especial need at this time for cutting loose from the apron strings of the paternalistic Chemical Foundation, which had made the Journal possible at a ridiculously low price for so long a time; the need for good management of the Federation affairs and the Journal by a paid manager or secretary. Especially did Mr. Pearse emphasize the need for promoting and fostering research and establishment of sewage works standards in operation as well as equipment specifications of national scope developed through the work of non-existent committees coordinated by the secretary of a national organization to preclude duplication and waste. Only through a set-up such as that now proposed in the new Constitution and with whole-hearted manufacturers' support could such attainments be realized. Above all, a national association and annual conventions should be expected to develop the operator group as had been experienced in the allied field of water supply.

Others who voiced a sentiment in

Langdon Pearse, San. Engr. Chicago Sanitary District

(Did a bang-up job in his "sales talk" — Why a National Sewage Works Ass'n.)

Wm. J. Orchard, Gen'l. Mgr. Wallace & Tiernan Co.

(Master of Finances — Turned Over to the Federation a clear profit of better than $1,000 on the Convention)

favor of the reorganization were Clyde C. Kennedy of San Francisco, representing the California Association; Dana E. Kepner, secretary of the Rocky Mountain Association; N. L. Nussbaumer, immediate past-president of the New York Association; B. A. Poole, president of the Central States Association, which had the day previously passed a resolution favoring the principle of the proposed Federation reorganization and nationalization as outlined in the new Constitution studied by C. S. W. A. officers.

Thereafter W. J. Orchard presented the picture of manufacturer support, cooperation, affiliation and participation; what it could do, what it shouldn't do and hadn't done during

Dr. F. W. Mohlman
Chicago Sanitary District
(Editor, Sewage Works Journal)

Linn H. Enslow
New York City
(Vice-Chmn. of the Board)

the Manufacturers' Association handling of A. W. W. A. convention exhibits in exchange for fixed financial support freed of any strings whatever. (Later in the meeting the Board of Control learned at first hand how exhibitor feeds had permitted the Manufacturers' Association to contribute funds sufficient to clear up all convention expense and return to the Federation's treasury a sum better than $1,000.) Since the interests of the sewage works operator, the engineer and the developer and purveyor of equipment and materials are basically the same, Mr. Orchard pointed out that the convention constituted a National Exchange in which all participating gained decided benefits and neither group should profit at the expense of any other. The present convention had proved a good "sample" in this direction as many could attest.

Following Mr. Orchard's comments, a resolution introduced by B. A. Poole voiced about the same sentiment expressed by the Central States Association the day previous. It read in effect "That this meeting go on record in approving the spirit and intent of a strengthened Federation. It therefore recommends to the present Board of Control that favorable action be taken on the proposed revisions and additions to the Constitution and By-laws to make possible a Federation of more national scope." This resolution was passed without a dissenting vote.

Board of Control Meets

At a subsequent 3½-hour session of the Board of Control, in which all but three affiliated associations were represented, so successful had this first convention been that one of the first motions passed was that calling for the holding of the second Federation convention in 1941 and the early naming of a Convention Management Committee for the purpose of choosing the place and selecting dates. Then followed a motion to incorporate the Federation as a non-profit corporation for the purpose of protecting its officers and members of the Board.

From this point on the Board literally took apart each section of the proposed Constitution and By-laws, during which numerous minor changes were suggested and the whole improved and strengthened as a result. Most attention was fixed on the new office set-up and the matter of dues and their collection. In the end a sub-committee was named to introduce the suggested changes into the document, and promptly circulate it for further comment from executives of affiliate Associations. Then followed a resolution to the effect "That this further modified draft of the Constitution and By-laws should be considered for final adoption by the Board at its annual meeting in January, and put into effect promptly following ratification."

Back to the Convention

Much space has been given to the matter of proposed reorganization and actions on the revised Constitution because it is apparent that interest in what is happening and developing in this direction is at a high ebb throughout the sewage works

Past Presidents

(Each Received a Past-President's Emblem)—(1) *L. S. Finch, Cons. Engr., Indianapolis;* (2) *L. F. Warrick, State San. Engr., Madison, Wis.;* (3) *H. E. Babbitt, Prof. San. Engr., Univ. of Ill.;* (4) *C. K. Calvert, Chief Chemist, Indianapolis Water Co.;* (5) *B. A. Poole, State San. Engr., Indianapolis (Immediate Past-Pres.);* (6) *Geo. J. Schroepfer, Chief Engr., Minn.-St. Paul Sanitary Dist., Member of Board of Control. (Other Living Past-Presidents are M. Starr Nichols of Madison, Wis.; .O. M. Leonard, Prof.; F. M. Dawson, Univ. of Iowa. Two Who Have Died Were Wm. S. Kramer and H. F. Ferguson).*

fraternity and the more that is known regarding actual rather than fictitious developments the better for all concerned. We hope that the space devoted has been justified, and now return to the convention proceedings and activities.

In the matter of entertainment there could have been nothing further desired. The size of the contingent of ladies attending evidenced that no such extent or quality of entertainment was anticipated. Under the chairmanship of Mrs. Paul Hansen and her committee, the ladies were splendidly entertained, a rare treat being a tour of Chicago's famed North Shore, during which visits were arranged to homes of note and splendor, in one of which tea was served. Then there was the usual luncheon, style show and shopping tour.

Under chairmanship of Harry E. Schlenz the men were entertained with a smoker and floor show the first night. The second night was given over to the big dinner, floor show and dancing, the food, the music and the performances being of excellent quality and pleasing to all.

The final afternoon was devoted to an inspection trip to Chicago's collosal new Southwest Treatment Works, the world's largest sewage treatment plant.

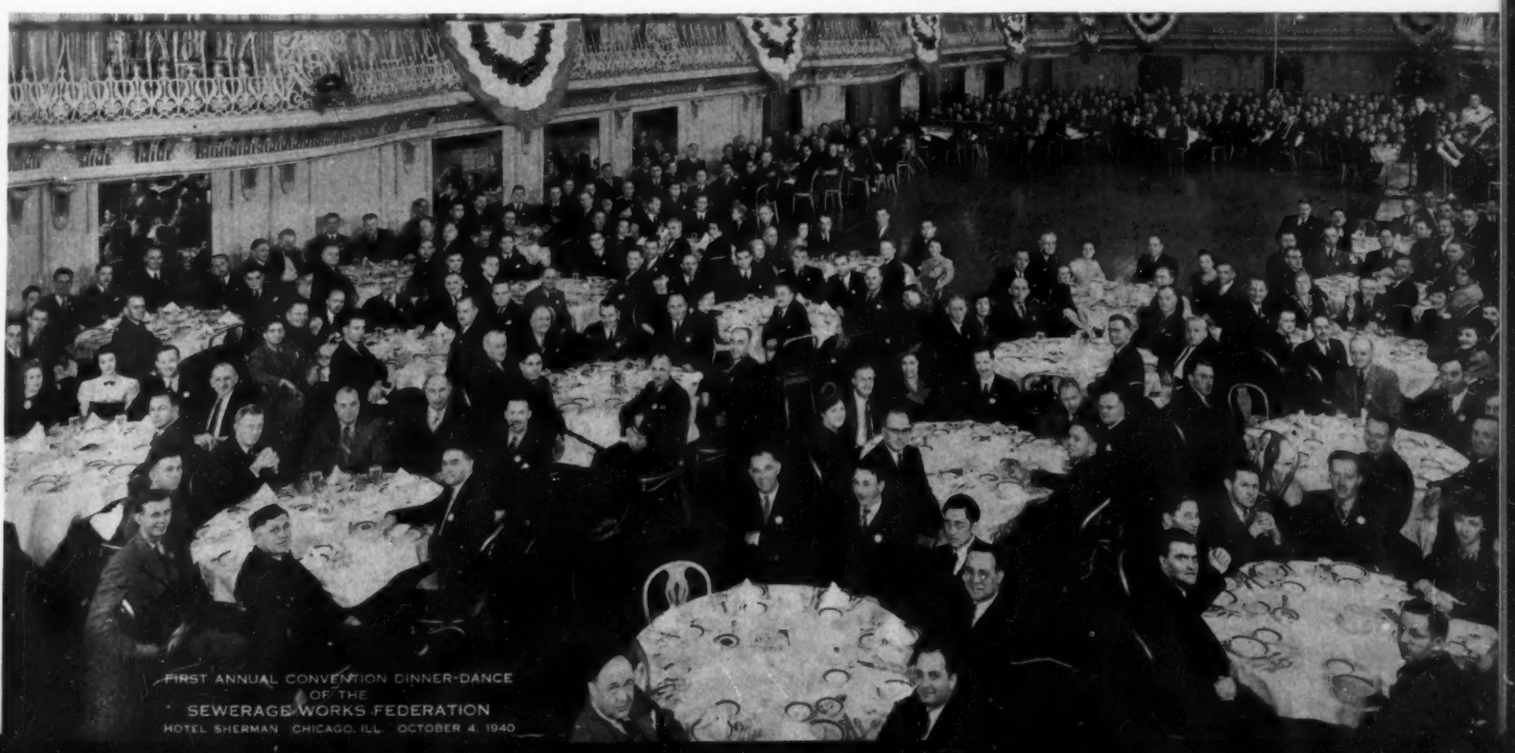
Wolman on Stream Cleanliness Standards

Apparently it was the thought of the Program Committee that it would "save the best for the last" because the closing feature of the convention was the luncheon address of Dr. Abel Wolman of Baltimore, who in his customary fettle did a splendid job in a quick analysis labelled, **"An Inquiry into Standards Proposed for Stream Cleanliness."**

Dr. Wolman's theme was that the only successful standards for stream cleanliness in the future would have to meet the specification of being logical, intelligent and balanced—not poetic, as had been many unsuccessful and wishful standards, proposed or actual, pictorially if not practically. Pointing to the dangers of being more poetic than practical in setting up water cleanliness standards, Wolman indicated the great present need for and trend toward standards capable of adoption on a wide geographical base. In respect to standards for bathing areas, he said that the situation bordered on the chaotic, indicating the need for a better balancing of practical necessities against epidemiological ignorance. In the matter of "tight-rope walking" in existing enforcing standards on none too sound a base, Wolman suggested a better consideration of the balance between convenience and public health without losing regard for either.

In making a few suggestions of "Federation Activities" of potential worth to the public and its members, Dr. Wolman proposed the following: First, the encouragement of follow-up stream surveys to prove contentions made by sanitarians proposing the adoption of sewage treatment with promised results not yet substantiated except in a few instances of general stream survey following clean-up programs. Second, the serious consideration of cost justification in regard to standards and corrective treatment of sewages and wastes. Proposing as much thought to the "C. O. D." values in stream cleansing as to the B. O. D. values, so ardently discussed in every meeting, he cited justification of costs vs. desires and benefits. As an illustration, he cited the lack of logic in enforcing a degree of treatment production of effluents superior to the receiving waters, productive of more "tight-rope walking" by authorities lacking more justification than a wishful desire or the creation of expensive example for others to follow. Third, then, there was needed an "Expediency Index" as much as a "Sludge Index" if sanitation was to proceed on a tenable base. Above all, it must be realized that to expect to produce a water environment of 1500 A. D. midst an adjacent land environment of 1940 A. D. could hardly be tenable. The question of priority of sewage treatment over other municipal functions needed broader consideration and an answer to the question of how far a municipality should be expected to proceed with sewage treatment in the initial step lacked much in the way of supporting evidence. These and many other matters seemed deserving of the attention of Federation committee of National scope capable of evaluating and passing on proposed standards and developing reasonable criteria of the economics of sewage treatment which is subject to support.

Looking ahead to the large expenditures to be made over the next two decades, Dr. Wolman believes that no more important problem faces the profession than how to steer a reasonable course between perfectionists and opportunists.



The Technical Sessions

"Some of the Newer Developments in Control of the Activated Sludge Process" by Dr. GAIL P. EDWARDS, Prin. San. Chemist, Dept. of Public Works, New York City.

This, the opening paper on the technical program was replete with an evaluation of factors of a basic nature in effective control of the activated sludge process, and presented some new conceptions and others of a supporting nature.

Dr. Edwards pointed out that the most valuable aids in operation to be a watch on the dissolved oxygen in the aeration units, the sludge index, the per cent of volatile matter in the sludge and the primary tank effluent, and microscopic examination of the sludge.

In respect to satisfactory values for dissolved oxygen at the outlet ends of aeration units much depends on local conditions and apparently more particularly the per cent volatile in the sludge. For instance, 2 ppm. proves satisfactory in Chicago whereas not less than 5 ppm. is so at the Wards Island plant of New York. As to the "Sludge Index" (ratio of dry solids by weight to sludge solids by volume in settled samples as determined by the Donaldson method), Dr. Edwards pointed out that this criterion varied with local conditions but that the changing of the local index gave warning of a changing operating condition. Here again the volatile content of the sludge had a bearing as evidenced in two New York plants—the index for Wards Island (high volatile sludge) averaging only 0.66, whereas that for the Tallmans Island Plant (low volatile sludge) the average is 1.7. These compare with figures of 1.37 for the Chicago Northside Plant and the very low figure of 0.50 for San Antonio where sludge return is held to a minimum for satisfactory operation.

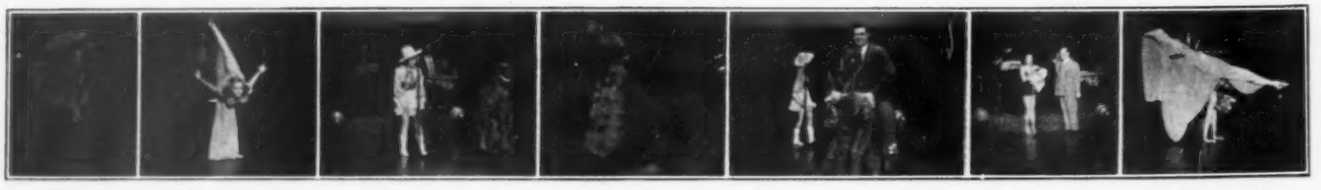
Concerning the optimism in sludge solids maintained in aeration units, Dr. Edwards said that this value varied markedly from plant to plant and no general rule had been developed since local conditions and sludge activity seemed to dictate. The marked variation is illustrated by averages of from 600 ppm. (dry weight) at Providence, R. I., to about 4,000 parts at Milwaukee. Averages between 1500 and 2500 ppm. seemed to apply generally, with the 1500 figures giving most dependable results at the Wards Island Plant.

The Gallery and Parts of the Dinner Show
(The Victim in the Spot as Well as on the Spot, With His Neck Locked in the Magician's Guillotine, Proved to Be Art. Caster, Supt. of Treatment at New Castle, Ind.).

Since the factor of build up of the ratio of volatile matter in the sludge seemed to have so important a bearing in plant performance and control Dr. Edwards dealt with this phase at some length, it being a common difficulty in periods of dry warm weather. Data and graphs presented for the Wards Island and Tallman's Island plants of New York revealed the marked influence of volatile matter content in depressing the "Sludge Index" and decreasing the weight of solids per unit volume of sludge to be handled—in short, in increasing the bulkiness and decreasing sludge settleability, both of which spell trouble to operators and increased operating costs. The accompanying graph pictures the effect for the two plants located but a few miles apart. It was to be noted that the average volatile content of the Wards Island sludge for the year of practically 76 per cent (70 min. and 80 max.) gave much less favorable operating conditions and results than did the 58.5 per cent volatile average (min. of 40 per cent) for Tallman's Island which deals with a lower volatile and fresher sewage diluted by infiltration. The sludge condition at Wards Island makes for great difficulty in concentrating the waste sludge to a 3 per cent solids figure for subsequent handling.

Concerning the merits of tapered aeration Dr. Edwards explained the scheme utilized at Tallmans Island and now being incorporated in the two larger plants under construction. Conceived by R. H. Gould, then Chief Engineer and now Deputy Commissioner of Public Works, the scheme was dubbed "step aeration." (We think "stepped feeding" is more descriptive since the air input is not varied through the aeration units whereas the sewage is admitted in increments as the mixed liquor travels through the tanks.) In any event the scheme provides for complete sludge return to the inlet end. Any desired amount of sewage may be added therewith and the balance admitted at two additional points along the line of flow. With this scheme of "stepped feeding" naturally the ratio of oxygen input to volatile loading is greatest at the inlet end and decreases along the line of flow, to the outlet. In consequence "stepped feeding" and "stepped aeration" are coincidental and the latter the resultant of the first. With this scheme only 3.5 hours of aeration at 0.4 cubic feet per gallon air consumed has yielded results warranting adoption of the scheme in large plants under design.

Since the concentration of waste sludge, particularly if consigned to digestion units or lagoons, is of prime economic and plant performance consideration some study and attention had been given this phase of operation. And for satisfactory results had come from returning waste sludge to the inlet end of the plant for settling with crude solids. Fluffy solids not retained in



(Subdued Lights—or Something—Strained the Camera's Eye. Taken for a Ride on the "Jass-Ax" was Stanley Mogelnicki, Supt. of Treatment at Birmingham, Mich. This Animule turned out to Be a Pretty Husky Gal, Just a Little Sway-Backed Though After This Performance.)

A Few Shots in the Exhibit Hall

(Dow; Crane; J-M; Chain Belt and W. W. & S. Booths. In Ponderous Discussion—"Bill" Piatt of Durham, N. C., and Frank Woodbury Jones, Cleveland).

the clarifier has resulted deleteriously to volatile content of the sludge and a depreciated "sludge index." Sludge concentration in separate thickening units designed for the purpose had yielded satisfactory results—particularly so when aided by chlorine application in moderate amounts to the top liquor or the inflowing sludge or both. In this scheme the maintenance of 1 p.p.m. chlorine residual (or somewhat more) in the overflow liquor had served as the chlorine control index. The required dosage had varied with sludge condition, but averaged 30 ppm. based on volume of waste sludge so treated. Trials of chlorine solution dispersed in the top (clear) water only and in the sludge entering the thickener had given results about equal and a scheme of splitting application between entering sludge and top water had been adopted for the reason that greater ease of residual control had been attained thereby.

Always of interest to operators Dr. Edwards comments on sludge bulking and correctives was intently listened to. At the Ward's Island plant chlorination of return sludge for control of bulking he said had been demonstrated in the gigantic scale of 50 mgd. flow and had proved a meritorius bulking corrective and in an adjunct in even-keel operation. Sludge bulking, said Dr. Edwards seems to be a certain sign of volatile matter build up in the sludge. It occurs prevalently in drought periods of greater concentration of non-settleable solids and disappears promptly after a freshening and diluting storm. Since return sludge chlorination had been tried elsewhere with success as a bulking corrective one 50 m.d.g. unit at Wards Island was employed for testing out the process at various dosages of chlorine to the return sludge. It was pointed out that bulking at Wards Island is mainly the result of volatile solids build up and only occasionally is the stage of filamentous organism growth of magnitude reached in the chain of events leading to sludge bulking. For six months two tank batteries treating 50 m.g.d. each and operated as nearly as possible alike were employed in the sludge return chlorination test. To the returned sludge of one battery chlorine was added in an amount of 1.8 p.p.m. based on return sludge volume, this dosage being determined by trial of more and less chlorine during adequate periods. The net result was a 35 per cent improvement in the "Sludge Index" records of the chlorinated battery. Eventually bulking in the central battery made it advisable to chlorinate that unit also resulting in the "Sludge Index" mounting to 0.75 as the average for both batteries and the same as observed for the battery first chlorinated. *Dr. Edwards* stated that the appearance of filamentous organisms such as sphaerotilus over reached objectionable development in the mildly chlorinated sludges and that a slight overtreatment had resulted in nothing more harmful than a milky appearing effluent, due to floc peptization which quickly corrected itself upon reducing the chlorine feed.

Exhibits and Entertainment

O. T. Birkness, Chicago Mgr., W. & T. Co., H. E. Schlenz, Sales Mgr., "P. F. T." Co., J. Hermann Smith, Hershey Meter Co., Boston. (The First and Third Were Responsible for Exhibits and the Second Had Charge of Entertainment. Hats Off to All Three!)

Don E. Bloodgood, Supt., Indianapolis Actuated Sludge Plant, in a prepared discussion of Dr. Edwards' paper, pointed out that the "Sludge Index" was too generally considered as an indication of sludge conditions rather than a measure of plant condition. He also commented on the fact that the "index" was influenced by the quantity of sludge maintained in the aerators—a fixed dilution should be set in standardizing the index. Diluting mixed liquors first to a standard solids content before making the index determination had been practiced at Indianapolis. In operating control a rigid rule at Indianapolis is never to allow the return sludge concentration to exceed the "sludge index." This practice was evolved as a measure for precluding too long a detention of sludge in the final clarifiers before getting it back to the air again. Mr. Bloodgood prefers the Donaldson method of deriving and recording the "index." Since it is always a rule that improved sludge quantity (higher index) is secured by reducing the sewage input to the aeration units (in

(1) *Frank Lovett of Link-Belt Co. and Mrs. Frank;* (2) *Clifford Cox, "P. F. T." of Chicago, and Robert Barr, American Brass Co., Waterbury, Conn.;* (3) *From Atlanta, Ga.—Wm. A. Hansell, Engr. of Sewers, Van P. Enloe, Supt. of Treatment Works and Mrs. Enloe;* (4) *L. P. Lessard, Dist. Mgr. for Darling Valve Co., and Ralph J. Bushee, Sewerage Engr., Fort Wayne, Ind.;* (5) *"Doc." Hatfield of the Decatur San. Dist. Did a Bit of Proud Smiling When Snapped With His Attractive Daughter of Sweet-Sixteen—Can't Blame Him Either.*

consequence the organic loading), Dr. Edwards' supposition that the increase in volatile content of sludge is productive of settling deficiencies leading to bulking sounds plausible. Experiences with return sludge chlorination at Indianapolis had shown no benefits nor had there been any harmful result.

Dr. F. W. Mohlman (Chicago Sanitary District) said that the question of volatile content of activated sludges was a very important basic consideration and, in his opinion, determining and watching the short period oxygen demand of the sludge was believed a fundamental guide in controlling operation. Regarding recent research, nothing in the way of practical application had been evolved. In respect to "Sludge Index" as derived from the Mohlman method and Donaldson's scheme, the two were only different in computation. If the Donaldson index is divided into 100, the resultant figure is the Mohlman index.

Dr. W. Rudolfs (N. J. Exptl. Sta.) expressed no surprise at the role of increase in sludge volatiles in producing a bulky plan settling sludge for this effect went hand-in-hand with variations in the oxygen demand (B. O. D.) of the sludge.

"The Role of Sphaerotilus in Activated Sludge Bulking" by C. C. Ruchhoft and John F. Kachmar, Jr., Prin. Chemist and Asst. Chemist, respectively, U. S. P. H. S., Stream Pollution Investigations Sta., Cincinnati, Ohio.

Based on studies made at the Cincinnati experimental station, it is the opinion of these investigators that Sphaerotilus Natans growth in activated sludge is not the direct cause of sludge bulking but its appearance, being concurrent with bulking, it is rather an indicator of conditions responsible for bulking. A study of Sphaerotilus growth, once started, indicated the optimum temperature for multiplication to be at 30° C., with a decrease noted below 20° C.

Californians

H. W. Jewell, Pacific Clay Prod. Co., Los Angeles.

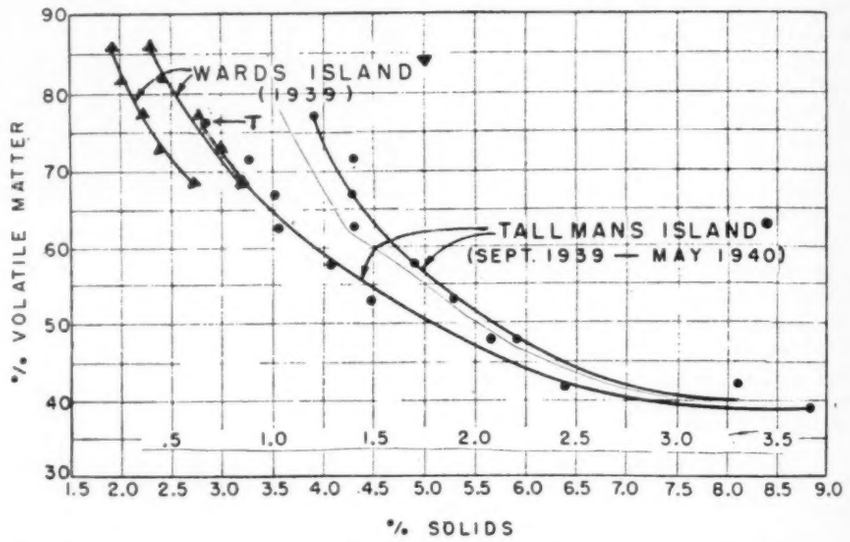
Benjamin Benas, Supt. of Sewage Treatment, San Francisco.

Clyde P. Kennedy, Cons. Engr., San Francisco.

(In All, About 10 Came from the West Coast).

and above 37° C. Under 10° C. there was little or no growth. Concerning pH effects, excellent growth appeared at values up to pH 9, a diminution being noted only below pH 6, indicating thereby that boosting pH with lime to be of questionable practical value as a corrective. The organism quickly reduces high pH, through lactic acid formation and thereafter gains rapidly. The presence of carbohydrates markedly stimulates growth, but prove not alone responsible. Sudden change in any one of the three controlling factors—food input (plant loading), temperature of sewage, or lowered oxygen ratio to food input—will cause bulking and Sphaerotilus growth increase. Of these, changed food input appears the most consequential.

With deficient air input, Sphaerotilus produces lactic acid, whereas with adequate air only CO_2 is produced. Sphaerotilus sludge appears particularly favorable to zoological bacteria growths and poor sludges seem to exhibit a "hang-over" effect which diminishes for some time their absorption and adsorption capacity. It seemed fortunate that during bulking the rate of Sphaerotilus growth diminishes along with the dropping ratio of oxygen input to oxygen demand. Further, that the organism continues to flourish only under conditions most favorable to its growth. In summarizing, the authors expressed an opinion that most sludge



Relation Between Per Cent Solids, "Sludge Index" (Donaldsons) and Volatiles in Activated Sludges

(Note: Figures Above the Base Line Represent "Sludge Index"—See Long Line Curves to Right of the Short Solids Curves on Left).

(1) Wm. Piatt, Cons. Engr., Durham, N. C.; (2) Earnest Boyce, State San. Engr., Lawrence, Kan.; (3) Francis Veatch, Black & Veatch Engrs., Kansas City; (4) Roy M. Harris, State San. Engr., Seattle, Wash.; (5) Wellington Donaldson, Chief Bureau of Sewage Disposal, Dept. of Public Works, N. Y. City; (6) L. O. Williamson, State Sanitary Engr., Cheyenne, Wyo.; (7) Guy E. Griffin, Engr. of Sewage Disposal, Greenwich, Conn.; (8) Paul Molitor, Sr., Supt. of Sewerage, Madison-Chatham, N. J. (This New Jersey Dean of Operators Has Seen a Very Small Acorn Into a Mighty Oak Grow).

(1) *Prof. Gordon M. Fair, Graduate School, Harvard University;* (2) *Gilbert Frith, Georgia Dept. of Health, Atlanta;* (3) *A. L. Fales, Metcalf & Eddy Engrs., Boston;* (4) *Klassen, State San. Engr., Springfield, Ill.;* (5) *W. G. Willard, Supt. Treatment Plants, Spartanburg, S. C.;* (6) *A. H. Niles, Supt. of Sewerage, Toledo, Ohio.*

bulking may be traced to deficiencies in plant design or operation, but in many instances also to sudden changes in the character of sewage and volume, again emphasizing that Sphaerotilus growth was more the result and the indicator of the true causative effects responsible for oxygen deficiencies leading up to sludge bulking and what follows.

Dr. H. Henkelekian, N. J. Experimental Sta., New Brunswick, N. J., in a scheduled discussion prepared without benefit of the paper, said that a bulked sludge was either a diseased sludge or an indicator of deficiency in total oxygen input on its most effective distribution through the aeration units. Since bulked sludge was a spongy sludge and presented a larger oxygen absorbing surface to increase rates of oxygen depletion, a vicious cycle was created by bulking and quick remedies were therefore imperative. The effects leading to bulking were cumulative and emphasized the "ounce of prevention" rather than the "pound of cure" axiom in activated sludge plant operation.

Correctives and preventatives suggested involved a reduction of return sludge as the first and simplest measure. The possible dilution of dry weather sewage with effluent in stream water was another potential aid and also the chlorination of return sludge. And a boosting of air input at the inlet end of the aeration unit or the introduction of a portion of the incoming sewage further along the line of aeration constituted a corrective remedy and likewise a preventative measure. As to contributing causes of bulking, the matter of baffling aeration units to preclude short-circuiting, and the more rapid recirculation of sludge deserved more attention.

"The Role of the Trickling Filter in Sewage Treatment" by Dr. Max Levine, Head, Dept. of Bacteriology, Iowa State College, Ames, Ia.

Dr. Levine presented a splendid case for the trickling filter and in particular the high-rate filter, as it is known today. He first reviewed some of his early work involving high applications of oxygen demand to crushed stone filters in treating milk wastes in which these units were shown to possess the dual value of serving as de-colloiders as well as oxidizing units. In the last regard the worth of proper ventilation was demonstrated by an increase of 1.3 parts of nitrate nitrogen to 18.8 parts in the effluent as the result of effective natural ventilation.

Concerning the most effective dosing cycles in operating such filters, Dr. Levine's studies revealed, in data presented, that the secret to the success of high-rate or high B. O. D. loaded filters lay in frequent applications, or continuous application of the applied liquid. In comparing various cycles, the shortest cycle (2½ min.) produced an average of 90.6 per cent B. O. D. reduction compared with only 77.8 per cent reduction for the longest cycle (20 min.) studied. The explanation lay in the fact that the B. O. D. value at maximum rate of effluent discharge from the 20 min. cycle dosing mounted to 428 p.p.m., whereas for the 2½ min. and 5 min. cycles the highest B. O. D. value during peak discharge rate did not exceed 95 to 108 p.p.m of added significance was the observed fact that at the 20 min. frequency 45 per cent of the total flow passed through the bed at a rate just about 7 times that of the essentially constant rate of discharge observed for the 2½ min. frequency of dosage.

In discussing the important role of the trickling filter as a decolloider the agglomerating capacity of the units was emphasized as the feature of greatest importance in the so-called high rate units which placed them in the category of bio-flocculation devices and closely akin to the floc-forming activated sludge process when stopped short of nitrification. Dr. Levine in the direction cited the performance of filters loaded at 2 to 16 mg./acre/day to emphasize the fact that in the low rate filter only 20 per cent of the overall B.O.D. removal was performed through settleable floc formation, whereas for the 16 mg. rated unit B.O.D. removed in the form of settleable floc formed amounted to 81.5 per cent of the overall removal. Thus was emphasized the relative values of effective settling units following high-rate filters.

Thus effectiveness of high rate filters hinged more on the efficiency of post-settling units than on primary units. In the case of the high rate unit the loading of 4,500 lbs. of B.O.D. removed per acre-foot of filter compared with only 469 lbs. for the standard filter—the first producing

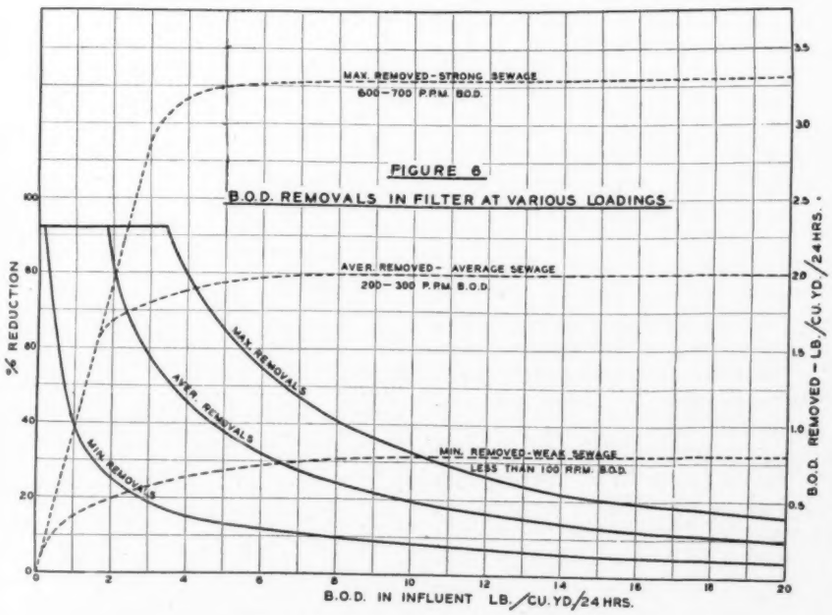


FIGURE 6
B.O.D. REMOVALS IN FILTER AT VARIOUS LOADINGS
MAX. REMOVED - STRONG SEWAGE
600 - 700 P.P.M. B.O.D.
AVER. REMOVED - AVERAGE SEWAGE
200 - 300 P.P.M. B.O.D.
MAX. REMOVALS
AVER. REMOVALS
MIN. REMOVALS
MIN. REMOVED - WEAK SEWAGE
LESS THAN 100 P.P.M. B.O.D.
% REDUCTION
B.O.D. REMOVED - LB./CU. YD./24 HRS.
B.O.D. IN INFLUENT LB./CU. YD./24 HRS.

High-Rate Biofilter Performance
(*Removals of B. O. D. by Filters Operating at Various Loadings*).

89.4 per cent purification and the latter only 90 per cent and the B.O.D. values of the two final effluents being 24 (115 before settling) and 17 p.p.m. respectively. Dr. Levine added that this 24 parts could have been even further reduced if a straining filter had followed the clarifier and seemingly such units were justified to cope with the more fluffy and buoyant floc particles.

Discussing the hazards of clogging of high-rate filters, Dr. Levine cited the early high-rate roughing cinder beds (7 min. dosing cycles) installed at a meat packing plant in Mason City, Ia., under his direction in 1929, followed by standard rate stone filters. At this plant the activated sludge process had failed. These roughing filters had been designed for cleaning by back washing. The success of this arrangement had led to an installation of similar design at the Armour Co. plant in Fargo, N. D. (For a description of the plant, and operating attainments by its designer, L. R. Hanson, refer to the May, 1940, issue of this magazine. —Ed.)

At the former plant treating a waste averaging 1400 p.p.m. B.O.D. the high-rate unit plus intermediate clarifier removed 63 per cent of the B.O.D.; the final filters and clarification another 31 per cent. At Fargo treating a very similar waste, where the high-rate units are equipped for air and water wash, up to the secondary filters the overall removal had averaged 70 per cent and the total for the plant 95 per cent. The removals cited for these rapid decolloidizing filters (including primary and post settling) amounted in terms of B.O.D. removed per acre-foot to the remarkable figures of 6,000 lbs./acre-foot at Mason City and 5,420 lbs. at Fargo. The secondary filters with final settling had accounted for additional removals of essentially 1,000 lbs./acre-foot, which is at least twice the performance expected of standard filters treating domestic sewage.

In summarizing, Dr. Levine said that the oversight in considering the robust trickling filter as a "decolloider" or "agglomerator" rather than a nitrifying device, primarily had been responsible for failure to recognize its greatest value and economy as a treatment device during its past history. With frequent or continuous rates of application clarified wastes of extreme B.O.D. concentration could satisfactorily be applied directly to trickling filters on a practical basis. Medium or fine-grained washable filters could be expected to exhibit the best performance in dealing with the more concentrated wastes and for handling marked fluctuations in plant loadings. Following such decolloidizing units the secondary process, if required, may be high or low rate trickling filters or the activated sludge process. In any event the high importance of efficient clarifier units following the agglomerating units must not be lost sight of.

Linn H. Enslow—Editor of this magazine, in a scheduled discussion of Dr. Levine's paper exhibited lantern slides of the first stage roughing filters at the Fargo plant of Armour & Co. and a typical single stage high-rate filter on domestic sewage, and described the operation of each. He referred to the effects

George Andersen, Supt., Rockville Center, L. I. (President of the N. Y. Sewage Wks. Assn.).

Dr. Gail P. Edwards, Principle Chemist, Dept. of Public Works, N. Y. City.

Dr. W. Rudolfs, Chief, N. J. Expt'l Station, New Brunswick, N. J.

of temperature on the efficiency of high-rate filters, citing the findings at Baltimore, Md., wherein those filters at rates up to 30 mgd./acre had satisfactorily handled loadings up to 5,000 lbs./acre-foot and with a sewage temperature of 75° F. in summer with superior overall results to those from a 6 mgd/acre during winter and sewage temperature of 54° F. or less, thus indicating the need for considering protection of high-rate units in very cold climates. At Fargo the waste temperature was sufficiently high to not lower filter efficiency to any appreciable extent in winter.

Concerning bed depths of such high-rate units the Baltimore studies revealed, even at the highest loadings, that very little was being accomplished below the 4 foot depth—a matter of only 12 per cent additional purification being attained through the lower 4 feet of the 8 feet deep beds. Mr. Enslow emphasized the value of the so-called high-rate filters for the smaller municipalities where a large seasonal load of industrial wastes had to be dealt with; likewise for resorts where the population load reached high seasonal peaks. To his thinking the most remarkable feature of the trickling filter was its ability to stand up against sudden shock and its recuperative rebound when and if seriously jolted. In this regard it stood out as the most practical of any sewage treatment devices. These filters had the remarkable power to adsorb a seemingly well defined weight of B.O.D. per unit of bed volume and reaching this limit nothing more serious happened than the passage of liquors with less overall purification but never any complete breakdown of the process either temporary or otherwise. A graph on the screen (here reproduced) he explained was taken from an article scheduled to appear in "Water Works & Sewerage." It clearly pictured B.O.D. reductions at various loadings of sewages of various strengths. It was pertinent to note that with increasing strengths of sewages the B.O.D. removal per unit volume of stone bed increased progressively up to a point where the loadings reached 4 lbs. of B.O.D./cu. yd./24 hrs. after which no further increase in B.O.D. removal was observed. However, the interesting feature was the sustained rate of removal without subsequent diminution created by "fatigue" resulting from super-loadings. In the case of industrial wastes (results not included in the graph) on good authority it had been reported that sustained removals for beet-sugar wastes (1650 B.O.D. upward) had reached 5.23 lbs./cu. yd./day and for distillery wastes (20,000 B.O.D.) such astounding removals as 15.5 lbs./cu. yd./day had been recently recorded.

Mr. Enslow said that in his opinion the expression "high-rate" filter was a misnomer because in actual effect the method of operating these units makes of them "low-rate" filters. The word high should be applied as "high-capacity" filters. No clearer illustration of this reasoning was available than that presented by Dr. Levine wherein his tables of data indicated that the lowest *rate* resulted from continuous or very short period intermittent application. For a given total loading the highest rates of passage were observed when the periods between dosings were the longest. Possibly the erroneous designation "high-rate filters" would stick to units treating more than 3.5 mg./acre/day but in reality the high rate filter is the old standard filter through which a deluge passes at intervals.

[It is regrettable but necessary to carry the balance of this report over to our next issue.—Ed.]

THE REHABILITATION OF FORCE MAINS AT AKRON, OHIO

By WENDALL R. LaDUE
Sup't and Engineer
BUREAU OF WATER SUPPLY
AKRON, OHIO

AKRON, Ohio, an industrial city with a population of about 242,000, located in the northeastern part of the State, obtains its water supply by impounding the water from some 207 square miles of watershed contributory to the upper Cuyahoga River. This watershed is largely farm land, there being only a few small villages within the watershed. From the Treatment Plant near Lake Rockwell, the principal impounding reservoir, the moderately soft water is pumped to Akron through 11 miles of parallel 36-inch and 48-inch force mains, which are inter-connected at intervals of from 3,000 feet to one mile.

On the accompanying plan and profile of the mains is indicated the location of 20,000 feet of 36-inch main and 14,000 feet of 48-inch main (points A to D) which were recently rehabilitated by lining with cement mortar.

The original 36-inch main laid in 1913-1914 consisted of Lock-Bar pipe fabricated in 30-foot lengths of ¼-inch and 5/16-inch soft open-hearth steel plates. The specifications provided the coating of pipes by dipping in hot "coal tar pitch varnish," but this material was used on only about a half mile of the line owing to the difficulties encountered in controlling the mixture and the temperature of the bath and pipe. The remainder of the pipe was dipped in "Pioneer Mineral Rubber," then manufactured by the American Asphaltum & Rubber Company.

The Author

Leaks and Repairs

In 1919 after the 36-in main had been in service only about 4 years, leaks developed in the section between B and C (see plan). These were believed to be due to electrolytic action and an extensive investigation was carried on by the city of Akron in cooperation with the Traction Company. As a result of this investigation and corrections made by the Traction Company, the unfavorable condition existing was alleviated. [This phase of the problem was fully covered in papers by Mr. G. Gale Dixon and Mr. Victor B. Phillips, and published in the June, 1922, issue of the Journal of the New England Water Works Association.] Contract for the construction of a portion of paralleling 48-inch main had been let before the condition disclosed by the investigation was known to exist. However, following the investigation it was deemed satisfactory to use steel pipe for the new main, with the exception of about 4,650 feet, where conditions favorable to electrolytic action were most pronounced. Cast iron pipe was used for this section, otherwise the construction was 48-inch Lock-Bar pipe fabricated in 30-foot lengths from

Machine and Equipment Used in Lining Akron Mains.

5/16 to 7/16 inch soft open-hearth steel plates and coated with Hermastic Enamel.

Although the unfavorable electrolytic conditions had been alleviated, leaks apparently resulting from corrosion started by this cause contined to develop in the mains. For the past five years, repairs on the two mains have averaged 40 per year. Each repair necessitated the shutting down and draining of a portion of the main between valves and operating with an increased head on the pumps during time of making repairs. By January 1, 1940, the number of repairs on the two mains within the limits of A and D had reached a total of 516, of which total 480 had occurred on the 36-inch main, with 273 concentrated in the 4,650-foot section between B and C on the plan. The leaks, in general, were caused by small holes less than ¼-inch in diameter in the bottom of a larger corroded spot on the outside of the pipe. Effective repairs were made by driving a drift pin through the hole, tapping the hole, and inserting a ⅝-inch or a ¾-inch boiler repair plug therein. Where it was not possible to repair the leak by insertion of a boiler plug, a plate was welded over the hole either on the inside of the pipe or on the outside, as determined from the conditions encountered.

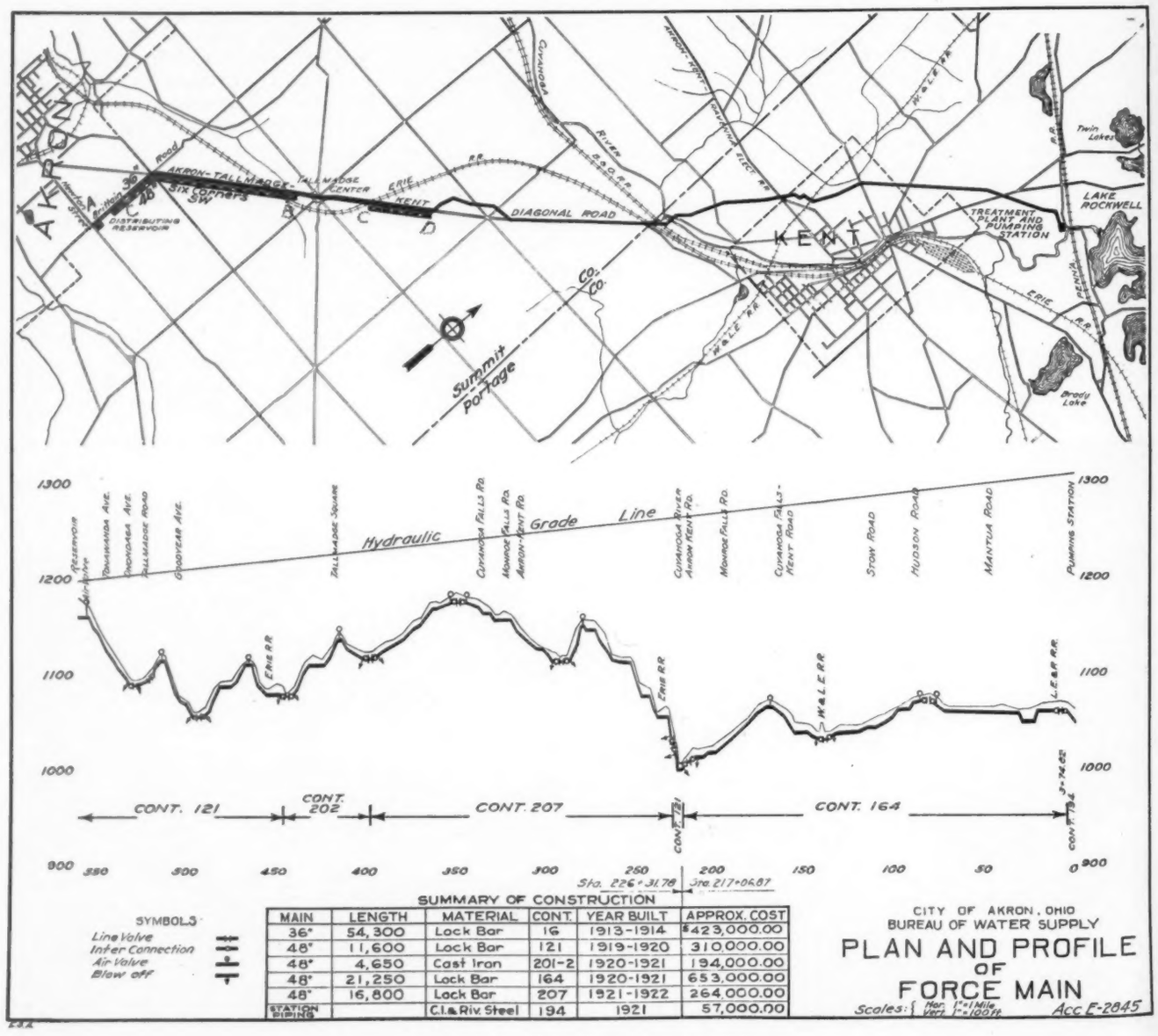
Rehabilitation Methods Investigated

In spite of the relatively large number of repairs, it was felt that, since the affected areas comprised such a small portion of the total length and area of the pipes, some form of rehabilitation would be justified. Welding of the corroded pits was at once rejected as impractical and too expensive, as the uncovering of the mains would occur in paved highways.

For several years the process of lining steel pipe with cement mortar, as developed and used by the T. A. Gillespie Company, has been observed with increasing interest. It was finally decided to line approximately 20,000 feet of the 36-inch and 14,000 feet of 48-inch main using this process.

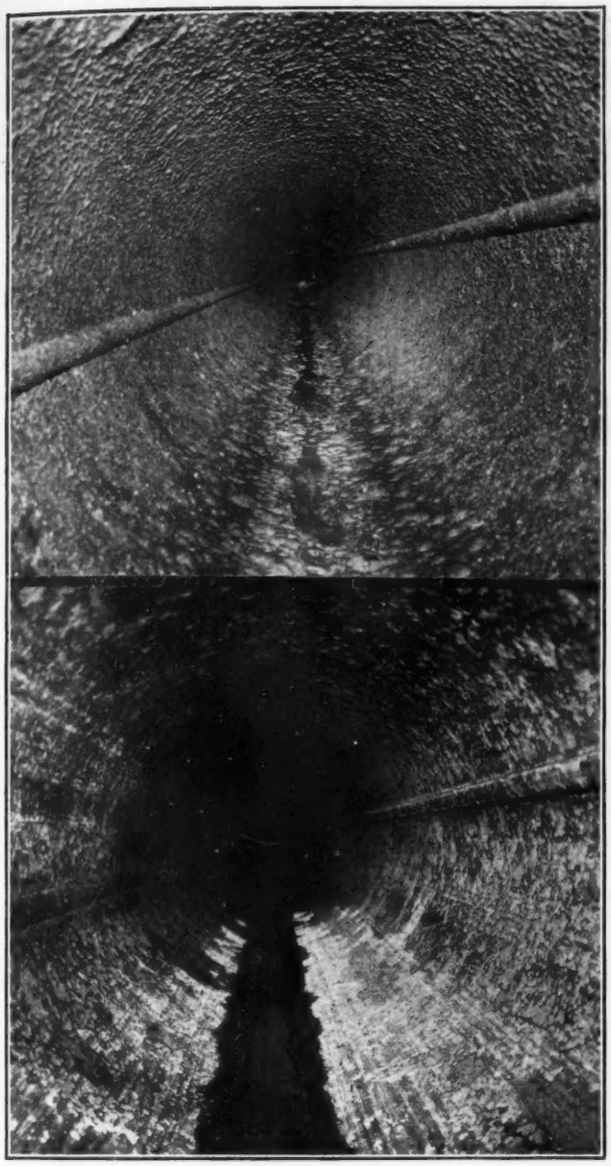
The adoption of this method was based on the conclusion that the pipe lines were, in general, structurally sound, needing only a seal coat to prevent the escape of water when small areas become so thin that the scale would not hold the pressure.

In support of this assumption the

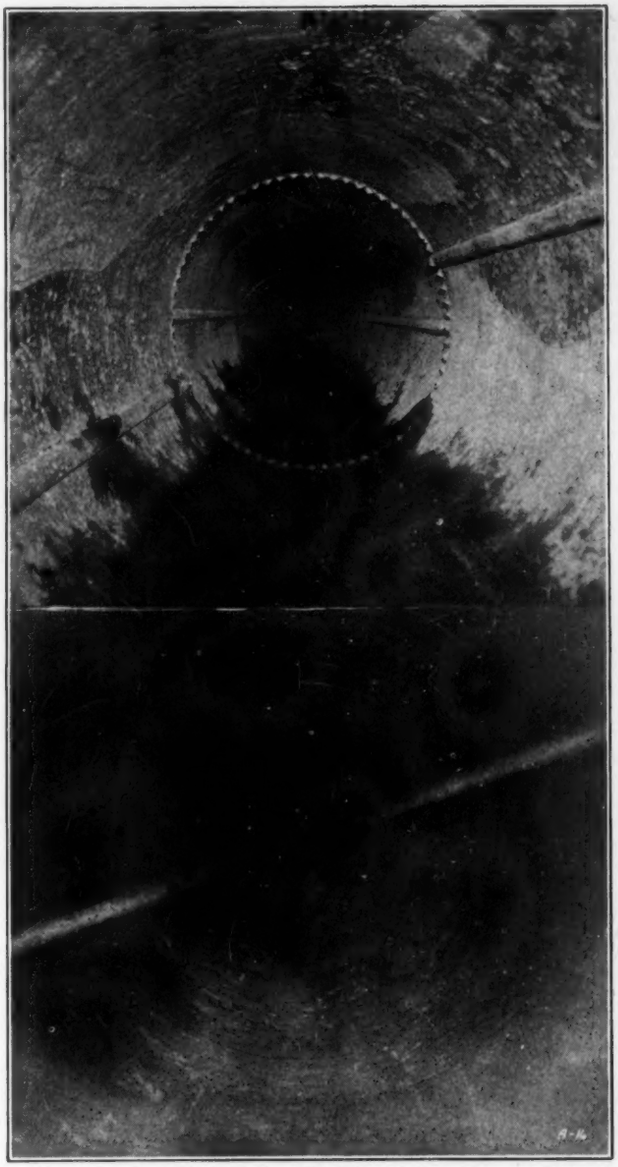


MAIN	LENGTH	MATERIAL	CONT.	YEAR BUILT	APPROX. COST
36"	54,300	Lock Bar	16	1913-1914	$423,000.00
48"	11,600	Lock Bar	121	1919-1920	310,000.00
48"	4,650	Cast Iron	201-2	1920-1921	194,000.00
48"	21,250	Lock Bar	164	1920-1921	653,000.00
48"	16,800	Lock Bar	207	1921-1922	264,000.00
STATION PIPING		C.I. & Riv. Steel	194	1921	57,000.00

Plan and Profile—Akron Supply Mains.



Thirty-six inch Lock-Bar Main Before and After Passage of the Cleaning Machine.



(Above) 36 inch Main Machine Cleaned and Hand Brushed. (Below) After Cement Lining.

engineers of the Bureau of Water Supply conducted a series of tests, as described hereafter, to determine the strength of the mortar lining in case the corrosion at a single point extends over a relatively large area. One-quarter inch plates were bolted to the ends of a short piece of 8-inch flanged pipe. One plate was tapped for a water supply line and combined air vent and pressure gage connection. The other plate was the test plate and was prepared as follows: A hole was drilled in the center of a ¼-inch plate to which a ¼"x¼" piece of steel bent to form a 7½-inch diameter ring had been welded to form a seal ring. A 1 to 1 mix of mortar, prepared as nearly as possible in the manner of that to be used for the lining, was applied within the ring and allowed to cure under water for a period of two weeks. At the end of this period, the plate was bolted onto the pipe and after removing the air from the pipe, pressure was built up by using a hand pump. Pressures were increased in increments of 20 pounds, holding each pressure for a period of several minutes before applying additional pressure.

The photographs show the general assembly of the test apparatus, the test plate in place, and a test plate with mortar ring in place.

Tests were made on holes varying from ¼-inch to 1¼ inch in diameter and pressures up to 200 pounds per square inch were applied with no effect in the mortar lining. There was a slight weeping through the mortar, and it was impossible to maintain a pressure of over 100 pounds per square inch for more than a few minutes. Later, when connected to the city mains (pressure 40 to 50 pounds) for a period of three days under this pressure, all weeping through the mortar stopped. These pressures more nearly approximated those to be encountered on the job. (It is now intended to continue similar tests on holes of larger diameter until the mortar actually fractures at 100 pounds pressuse.) It was decided to undertake the mortar lining project.

The Plan Followed

The cleaning and lining was carried on under an unusual three-way arrangement whereby:

(1) W.P.A. furnished labor for excavating, backfilling, hand cleaning of pipe, plastering, and doing other necessary work, and furnished the sand and cement for the lining.

(2) The City of Akron furnished labor, material, and equipment for doing all cutting and welding, for repairing of the main, and for making the necessary cuts for introducing equipment and material into the mains.

(3) The T. A. Gillespie Corporation, through a contract with the City of Akron, undertook the mechanical cleaning of the pipe (through the National Water Main Cleaning Company), the equipment for placing the cement lining, and provided general supervision over the project. [Shortly after the signing of the contract, the Centriline Corporation of New York acquired the cement lining interest of the T. A. Gillespie Corporation and completed the contract by assignment.]

A phase of the contract which had to be kept in mind constantly was the timing and coordinating of the work. Small portions of the mains had to be kept in service and increased head on pumping equipment maintained at a minimum. As stated before, the two parallel mains are inter-connected at intervals of one-half to one mile. The work was scheduled in such a manner that not more than two sections would be out of service at any one time, and as the work was done during the spring when the demand for water was comparatively low, the increase in head on the pumps was at no time troublesome.

The project involved three distinct operations:

(A) Preparing pipe for cleaning and lining.

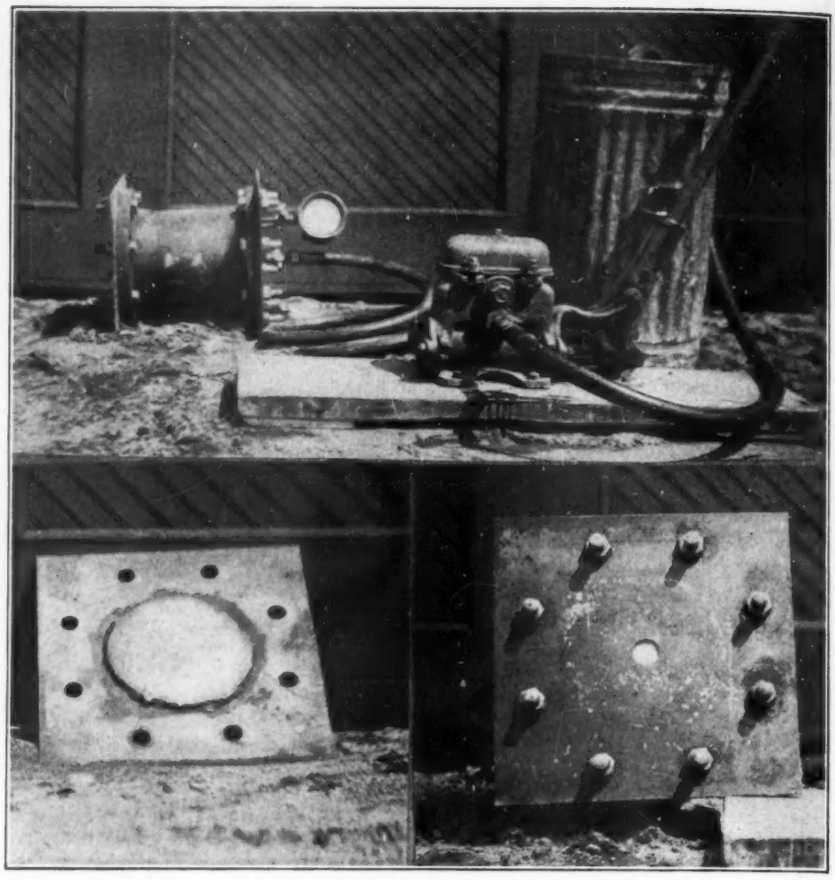
(B) Cleaning the pipe.

(C) Placing the lining.

Preparing Pipe for Cleaning and Lining

As previously stated, old leaks in the main had been repaired by the insertion of boiler patch plugs from the inside of the pipe. The heads of these plugs projected into the pipe as much as 1½ inches and had to be burned off before the cleaning machine could be sent through. Cleaning operations developed and disclosed approximately 200 additional holes which had to be repaired before the lining was placed.

Practically all leaks were repaired by welding a 4″x4″x¼″ plate over the hole either inside or outside as conditions dictated. In some instances the entrance of groundwater through the hole prevented the making of a tight weld. Where this occurred, excavations were made alongside the main and the groundwater lowered by pumping. In some instances even this failed to stop the outside leakage and tapered lead plugs were driven into the hole.



Equipment Used in Testing Strength of Mortar Lining Over Pit Holes.

Existing entry manholes spaced about 1,000 feet apart supplemented by holes cut into the top of the pipe permitted the entrance of the wires from the welding machines to the torches.

Two portable welding machines and four operators worked continuously at burning and welding in order to keep ahead of the pipe lining machine. A portable generating plant furnished power for operating the lining machine, for lighting, and for charging the storage battery cars.

Cleaning the Pipe

The mechanical cleaning of the mains was done by the National Water Main Cleaning Company of New York City. Their apparatus consisted of small stiff spring steel scrapers attached to structural steel rings in such manner that the outside diameter of the scraping edge was somewhat greater than the inside diameter of the pipe. Entrance to the pipe was made by using a short funnel section to compress the scraping edges. As the line valves on the 48″ and 36″ mains are 42″ and 30″ respectively, and since the cleaning machine could not be collapsed or otherwise made smaller, it was necessary to remove the machine from the main at each valve and reenter it on the other side.

The process of mechanical cleaning was as follows: A seven-foot section was cut from the pipe adjacent to one of the line valves controlling the section to be cleaned. The cleaning machine was introduced and the pipe section replaced. At the far end of the section another piece of pipe was removed to permit the discharge of the water during the cleaning process and the removal of the cleaning machine. The machine was propelled by water pressure through the pipe, regulating the speed by operating the valves on the main. The best results were secured at a speed of about 200 feet per minute. The waste water carrying the particles of coating removed from the pipe flowed past the machine and out thru the open end of the pipe at the far end of the section.

In order to prevent injury to the

pipe due to the sudden exit of the cleaning machine, a sand bag stop was constructed in such fashion as to permit only about one half of the machine to emerge from the opening. However, sufficient water was retained to create the head required to move the machine.

Two trips of the machine removed about 80 per cent of the coating. Photographs A and B show the condition of the pipe before and after mechanical cleaning.

At first the entrance section was welded in place and then recut and rewelded for the second cleaning. This delayed the cleaning operation to such an extent that the temporary coupling (here sketched) was developed. The coupling consisted of a ⅜-inch steel band 6-inches in width, drawn together by two ¾-inch bolts through 3″ x 3″ x ½″ angle iron lugs welded to the ends of the band. Before placing the coupling, a ⅝-inch circular section rubber gasket was placed on each side of the joint. When this coupling was drawn up securely, it was found to be quite satisfactory. When this coupling was no longer required, these pipe sections were welded in place.

Following the mechanical cleaning a force of W. P. A. laborers, varying from 10 to 20 men per shift, working two shifts daily, finished cleaning the mains with hand scrapers.

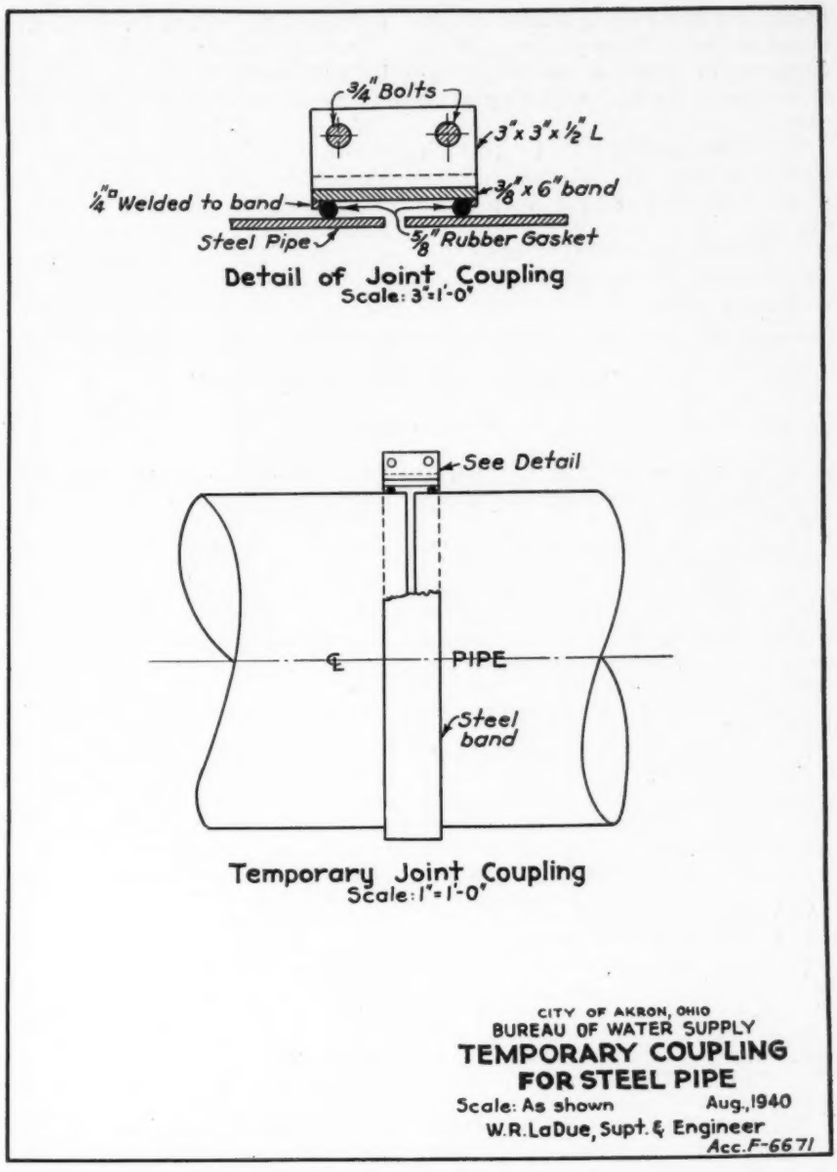
The laborers employed at hand cleaning were permitted to leave the pipe for 15 minutes each two hours. During this interval, blowers operating through the inlet manholes or other openings, forced fresh air into and through the mains.

The areas requiring considerable hand cleaning were generally at the riveted joints and about the lock bars. All coating, scale, or other foreign matter was removed from the pipe, leaving the steel plate in a clean condition. The hand cleaning was very thorough and, considering the conditions, it was carried out very efficiently.

One photograph shows the condition of the main after the hand cleaning was completed and the main was ready for receiving the lining.

Placing the Lining

The mortar lining, (1 to 1 mixture of Portland cement and dry-screened sand passing a No. 16 screen,) was of such consistency as to provide a dense and homogeneous lining that would hold itself against the pipe surface. The water-cement ratio was carefully controlled and kept to absolute minimum.



Temporary Coupling Designed for Closing Line After Inserting Cleaning Machine.

The lining, ¼-inch to ½-inch thick, was placed by a rapidly revolving motor driven head which threw the mortar against the pipe where it was smoothed in sequence by a series of paddles attached to the machine. A dense, hard surface resulted. The speed at which the machine traveled along the pipe determined the thickness of the lining. For ¼-inch lining, the speed was about 3 feet per minute.

At certain positions of the lock-bar the paddles appeared to drag mortar away from the lower side of the lock-bar, leaving occasional porous sections. These were removed and hand patched as soon as the lining had set sufficiently to permit the cement finishers to enter the pipe.

By removing the paddles the lining apparatus could easily pass through the 42-inch and 30-inch valves and it was unnecessary to remove the lining machine at each valve. For economic reasons the travel between the mortar mixer on the outside and the lining machine inside was limited to approximately 1,000 feet. It was therefore necessary to supplement the existing inlet manholes by cutting 18″ x 24″ plates from the top of the main in order to provide openings for introducing mortar within this travel limit. The travel of the lining machine being toward the mixing point, there was no travel over the newly placed lining. The lining set up quickly and if necessary the main could be placed in service within 48 hours after lining.

The mortar was mixed above ground and conveyed to the hopper of the mixing machine in storage battery operated cars. Two portable mixers were used, the one not en-

gaged in mixing being always set up ahead at the next opening so that no delay would occur as the lining machine passed the mixer opening being used.

An accompanying photograph clearly shows the interior of the pipe after the lining had been placed.

Upon completion of the lining, the section of main was sterilized with a chlorine compound and flushed before being replaced in service.

Actual lining operations were begun March 6, 1940 and the contract completed on June 15, 1940.

As the cost to the City, including engineering supervision, was less than $2.50 per foot of main lined, it is believed that the decision to rehabilitate the existing mains by applying the long lived smooth mortar-lining instead of adopting a policy of replacement, is fully justified by the results obtained.

Mr. A. E. Goodman, Associate Engineer, was the City of Akron's representative on the work assisted by L. W. Bausher, Jr., Engineer. Mr. O. R. Elting was Office Engineer. Mr. C. S. Erskine was the Contractor's superintendent, while the W. P. A. Field Supervisor was Mr. A. Anderson. Mr. W. F. Peters is Director of Public Service for the City of Akron.

"PUBLIC WATER SUPPLIES"

(Fourth Edition)

By F. E. Turneaure and H. L. Russell; 693 pages; $6. Publisher, John Wiley & Sons, Inc.

In my student days at the university, too many years ago, the bible for water supply reference was Turneaure and Russell. The edition we used was that of 1908. Like many other students and practitioners who were reared on this particular bottle, we looked forward with pleasure to a 1940 revision of this classic text.

It was with considerable excitement, therefore, that I rushed to review this volume and incidentally to compare it with that text which is still on my shelf and so thoroughly ear-marked through long usage. The findings are reported below:

The 1940 volume with its approximately 700 pages still appears to be the most comprehensive text on public water supplies. Its arrangement, its style, and its broad treatment are still distinguished characteristics of the volume. In many of its chapters, particularly Chapters VIII, IX and X, on the quality of water supply, major changes in the text have been made. These chapters reveal valuable contributions by Dr. M. Starr Nichols of the Wisconsin State Laboratory of Hygiene.

Similar comprehensive revision is provided in Chapter XXVI on pumping machinery, through the efforts of Professor Lenz of the University of Wisconsin. Less significant changes appear in most of the other chapters.

The volume is unfortunately marred by virtually no changes in a number of chapters, with the exception of a sentence or two in some, attempting to bring certain observations up to date. It is doubtful whether word for word repetition of material appearing 25 years ago with interspersings of a sentence or even a paragraph provide adequate treatment for many subjects as of 1940. However, even such limited revisions of an excellent early text still leaves an important contribution to technical literature.

Its appropriateness for University students is curtailed by incomplete adjustment of the text. For example, in Chapter II one may properly expect figures for foreign water consumption later than 1931-32 for England and Scotland; 1910-13 for Germany and 1908-13 for other foreign countries.

Similar comments may be made with respect to the population estimates in Chapter II. Therein Figure 5, for example, is exactly the same as in the second edition and the reader is not given the benefit of the modern trends in population growth now giving so much concern to students of the problem.

In Chapter IV some changes have been made, but the exposition by and large seems still to rest upon data and points of view and interpretations of the late nineteenth century. It may be questioned whether revision of a chapter, dealing particularly with phenomena on which considerable new information has been acquired, even during the last ten years, is accomplished when it rests upon material largely accumulated prior to 1900. These instances of inadequate adjustment of the revised edition to all of the potentialities of modern practice and experience are unfortunate.

In addition, the volume shows some evidence of careless proof-reading. Table 4, page 33, Chapter III, is perhaps one of the worst examples of this weakness. This table, the data of which have their origin in Engineering News-Record of 1939, purports to list the sources of water supply in the United States.

The present reviewer has attempted to use this tabulation, but one column at least seems to have disappeared from the table in the transfer from the original source to the present text. The data listed under the column "West of the Mississippi" appear to apply to the column under the heading "Far West." The data under the column "Far West" apparently do not represent that column at all, but are totals for all of the existent and non-existent columns. Within the table additional numerical errors occur. Some of the grand totals add up correctly, some give a figure which takes into account the errors of transfer, while others do not.

As one anxious to use this text for purposes of teaching, it would be reassuring to know that such errors are inherent only in this table, or whether the accuracy of other data is to be doubted also.

—ABEL WOLMAN.

W. R. Gelston, Sr., Killed in Automobile Accident

W. R. Gelston, Sr., for the past 33 years Superintendent of Water Works at Quincy, Ill., met an untimely death on September 27th when the car he was driving plunged down an embankment near Quincy. Mrs. Gelston and two of his sisters with him suffered serious injuries.

Mr. Gelston was well known in water works circles, had long been a member of the American Water Works Association and for two years served as Chairman of the Illinois Section and later as a Director. He was also a member of the New England Water Works Association, The American Society of Civil Engineers, and the Illinois Engineering Society.

Mr. Gelston was born on his father's farm near Elk City, Nebraska, January 1, 1868. He worked hard on this frontier farm and at 19 went to Grinnell College in Iowa from which he was graduated. His first engineering job was with the C. B. and Q. railway on line location work. On January 1, 1907 he was given the position of Superintendent of Water Works at Quincy, having continued in that capacity for the past 33 years. One of his two sons (W. R. Gelston, Jr.) has for sometime served as Assistant Water Works Superintendent.

Upon his death the local press gave much space to Mr. Gelston's attainments.

"The Quincy municipal water works, as it is today, is a monument to Mr. Gelston's ability and to the many years of devoted work that he gave to its improvements while he was superintendent. Practically all of his time, his energies and all of his thorough knowledge of the water works business were given to efforts to supply Quincy with an excellent water works system."

Upon Mr. Gelston's death the Water Commission held a special meeting to adopt resolutions lamenting the death of one who was recognized as one of America's outstanding water works executives and so considered by the Commission. The Commission thereupon announced W. Richard Gelston, Jr., as the new Water Superintendent of Quincy. Thus, the name Gelston will carry on for what it has long stood in Quincy and the water works fraternity at large.

N.E.W.W.A. HOLDS RECORD CONVENTION

New York City Meeting Draws Better Than 730

THE present-day axiom continues to be bigger and better water and sewage workers' meetings. With a record making registration of 730 the 59th Annual Convention of the New England Water Works Association held in New York City Sept. 25-27 proved the rule.

The technical program was good, the entertainment up to standard and the exhibits more interesting than usual. The only marring element during the week was the rainy day which came to prevent many from enjoying the trip planned to the World's Fair on Wednesday afternoon and evening.

Business Session

The convention opened with the customary Business Session wherein Secretary Gifford reported 33 new members for the year, making a total of 801. The Treasurer—Abel Reynolds—had the usual satisfactory report to make, indicating receipts of $11,138, and expenditures of $9,436.68, leaving a surplus for the year of $1,701.59 for investing. Income reported shows the following items:

Dues	$6,174.00
Div. & Interest	378.50
Advertising	3,748.60
Subscription	505.00

The report of the Editor—Gordon M. Fair—revealed the lowest net cost for the Journal production yet reported—namely, $4.83 per member, making it $3,846.46 for the four issues. At the same time the Journal carried the largest number of pages of articles in 10 years. Advertising being on the up, the highest profit yet made was reported—$618.37 net. This compares with $306 for 1938-39 and a net loss of $530 in 1938.

The Finance Committee—H. L. Field, chairman—set up the 1940-41 budget as follows.

Office Expenses	$4,550*
Journal	4,000
Committee	1,450

(*Inclusive of $2,016 in salaries.)

The Membership List is to be revised during the year at a cost of $475 and a Journal Index at $100.

The Committee on Investments—Leland G. Carlton, Chairman, after studying the low yield from a large fund in the aggregate held in several savings banks, recommended that no attempt be made at this time to put the reserve into investments because of the condition of the bond market with present high prices. This report came as the result of a criticism last year that the Association was needlessly conservative in sticking to savings banks and sacrificing income thereby.

Presidents

Percy A. Shaw
Supt. of Water
Manchester, N. H.
(Retiring)

Leland G. Carlton
Supt. of Water
Springfield, Mass.
(Incoming)

The Legislative Committee—Arthur C. King, Chairman—reported the only action of interest to be an extension of the Massachusetts Lien Law respecting unpaid water bills to include Water Districts.

The Committee on Committees—Warren J. Scott, Chairman — in N.E.W.W.A. is equivalent to the Water Works Practice Committee of A.W.W.A. The annual report constitutes a review of the work and progress of the many committees of the Association and effectively goes to the chairman of every committee. The following new committees are being established — "National Preparedness" and "Cathodic Protection of Steel Tanks and Standpipes." The latter committee will attempt to evaluate the various methods and types of equipment now being offered or to be offered. It was also recommended that the work of the present Publicity Committee be extended beyond Association publicity in an effort to bring before the general public a better realization of the importance of the water superintendent's job.

Vice Presidents & Director

1st V. P.—Francis H. Kingsbury, Engr. Mass. State Dept. of Health, Boston

Director—Horace L. Clark, Supt. Sanford Water Co., Sanford, Me.

2nd V. P.—Harold L. Brigham, Supt. Water and Sewerage, Marlboro, Mass.

The latter activity is in line with the ideas of the retiring president—Percy A. Shaw—in whose brief address at the closing session the keynote was a plea to water superintendents to bring their light out from under the bushel and take every opportunity to make the importance of the local water supply better known and appreciated by the general public. [To better do this the Association work can constitute a marked aid. Some of it has been done by the A.W.W.A. with a degree of success; it is hoped that N.E.W.W.A. will be able to do even a better job. —Ed]

A Message From and To Great Britain

At the Luncheon Session E. Sherman Chase, Chairman of Committee on Reciprocal with the Institution of Water Engineers of England, read a letter from Mr. John Bowman, President of the Institution of Water Engineers, to the Committee, which contained the following paragraphs:

"In the paper on British Waterworks Practice which was presented to your Conference last year I referred to Air Raid Precautions to be adopted by Water Undertakings in the event of war. Since then war has broken out and after a year the struggle has become narrowed down to one between the British Empire and the Axis Powers.

"Now that the enemy has disposed of other opponents it leaves them free to concentrate their full strength upon our Empire and particularly upon Great Britain. Air attacks are being made with persistence and are likely to increase in intensity. The public services are now called upon to face conditions of extreme warfare. From the results so far achieved by the enemy we may view the future with equanimity. Even where the attacks have been greatest the public services have functioned."

"Nothing has been so stimulating to our country in its struggle as the knowledge that behind it is the approval and the moral and material support which has come so generously from the United States of America. Your Association represents a certain section of this great nation and the Institution of Water Engineers is a representative British Institution. Let me, therefore, as President of our Institution, convey to your Association our feelings of goodwill and brotherliness."

At the conclusion of the reading of President Bowman's letter a resolution was offered by Percy A. Shaw, President of N.E.W.W.A., and was unanimously endorsed. It follows:

"BE IT RESOLVED, That we of the New England Water Works Association, assembled in annual convention in New York City, on September 24, 1940, extend to the Institution of Water Engineers our most sincere sympathy, with the fervent hope that a righteous victory will soon permit its members to return to the normal activities of peace."

Sampson Brackett Medalist

To George A. Sampson, Consulting Engineer of Boston, Mass., a past-president of the Association, was awarded the Dexter Brackett Memorial Medal for his paper "The Cost of Small Surface Water Supplies," which paper entailed the collection, assembly and analysis of much useful data. The presentation was made by Harry U. Fuller, Chairman of the Award Committee and past-president of the Association.

New Officers

In the closing Business Session the following were declared as elected officers for the ensuing year:

President—Leland G. Carlton, Supt. of Water, Springfield, Mass.

1st Vice Pres.—F. H. Kingsbury, Mass. State Dept. of Health, Boston.

2nd Vice Pres.—Harold L. Brigham, Supt. Water and Sewerage, Marlbough, Mass.

Directors:

Horace L. Clark, Supt. Sanford (Me.) Water Co.

Karl R. Kennison, Chief Engr., Metropolitan Water Com., Boston.

Harold W. Griswold, Deputy Chief Engr., Water Bureau, Hartford, Conn.

N. Y. Section of A.W.W.A. Holds Luncheon Meeting

Upon invitation from N.E.W.W.A. the N. Y. Section of A.W.W.A. arranged to hold a Luncheon Meeting during the convention. This it did and without question the arrangement resulted in a somewhat increased attendance at the Convention. As a speaker, Col. Willard Chevalier did one of his very best jobs of "Taking a Look at America's Future." The room was crowded at the beginning and still crowded at the end. That is just how good his timely talk was.

Brackett Medalist
George A. Sampson
Cons. Engr.
Boston, Mass.

20 Year Secretary
Frank J. Gifford
Cons. Engr.
Dedham, Mass.

Water Supplies During Time of War

This topic proved to be the high-spot on the technical program. It was introduced by one well qualified to review *"Experiences in Water Supply During the Last World War"* —namely, Col. F. F. Longley, of Lock Joint Pipe Co., and Colonel of the 26th Engineers in charge of water supply during the World War of 1914-18. Incidentally, few knew before this meeting that Col. Longley had been decorated with the Distinguished Service Medal in recognition of his World War service.

Arthur C. King, Supt., Taunton, Mass. (Chairman Legislative Comm.)
Robt. Spurr Weston, Cons. Engr., Boston (Chairman Comm. on Water Wks. Education)
Harold W. Griswold, Deputy Chief, Hartford (New Director & Exec. Comm. Member)

The Colonel's prepared paper contained an outline of basic methods employed in providing and purifying water supply for a field army, but he did not read it. He pointed out that the speed of army movements of today as compared with that of 1914-18 presented new and different problems in water supply for combatant zones. Training units were now utilizing mobile purification units of 40 gpm. capacity which would take care of a surprising number of men and animals in the field. Water supply for cantonments comes under two army agencies, the U. S. Engineers and the Quartermaster General's Dept., mostly under the latter. A.E.F. experience, with men then in the field, and now in high ranking position, was serving admirably in present planning.

In touching on preparations by water works managers for possible emergencies the Colonel said that the matter of paramount importance was that of knowing where and how quickly supplies and equipment could be procured in case of sudden need. He called attention to the first report of N.E.W.W.A.'s Committee on Emergency Procedures, which will serve as a good guide, although war emergency was not considered at the time of its preparation.

Don C. Calderwood, Chairman of the Committee, was then asked to say something concerning the report. He briefly summarized the nature of the report and stated that the Committee would want to add to its procedure specifically war measure methods, and invited further criticism and suggestions of an improved and broadened report covering all forms of emergency. [Anyone wishing a copy of this Emergency Procedure Guide may address a request to Don C. Calderwood, Nashua Water Works Co., Nashua, N. H., or to N.E.W.W.A. headquarters, Statler Bldg., Boston, Mass.—Ed.]

Major Arthur H. Pratt, Consulting Engr. of Newark, N. J., and former Water Supply Battalion Commander in the World War, in discussion, was highly laudatory of the skill of Col. Longley in his World War water supply work. At present, he said, no water supply battalion is contemplated, the U. S. Engineers assuming full responsibility and referred to Bul. 55—Army Order 101 covering Army Water Supply. He, too, praised the mobile purification units produced by W. & T. Co. for field use in the last World War. Now improved units and storage in canvas tanks on towers had been developed.

Col. Thos F. Wiggin, Consulting Engr., New York City, reminisced also on World War experiences in providing water supply in France, when Col. Longley came to the rescue in getting a Water Supply Battalion formed and water supply divorced from the Medical Corps and in the procurement of materials—notably 200 miles of 4 inch Universal Joint C. I. pipes for laying above ground quickly, and moving as required by non-skilled crews. Col.

E. Sherman Chase, Cons. Engr., Boston
(Chairman Comm. on Publicity & Relations)
Warren J. Scott, San. Engr. Hartford, Conn.
(Chairman Committee on Committees)
Abel Reynolds, Treasurer N. E. Water and Power Assoc., Providence
(Watch Dog of NEWWA'S Treasury)

Bartow's work in charge of Field Laboratories manned by Sanitary Corps personnel was also lauded. He never could understand it, but French C.I. pipe foundries, in the thick of it all, seemed to possess a charmed life in escaping shell fire. As to quantity of water provided for camps, in the early stages 2 gals. per capita was common in camps served by dry latrines. Later 15 gal./capita was supplied. In the U. S. cantonments were allowed 50 gal./capita. Sewerage was also turned over to the U. S. Department to operate and maintain.

Col. W. A. Hardenbergh, Vice Pres., "Public Works" Magazine, New York City, stated that the U. S. Engineers were planning on adding water purification engineers to the Corps. A modern mechanized Division consisted of 12,000 men instead of the 20,000 Division of 1914-1918. A modern division should require 4 of the modern pressure filter light-weight portable purification units now in field use. Another useful pressure filter was one involving paper pads and a hand operated force pump providing 2 gals./min.

E. J. Cleary, Associate Editor, "Engineering News Record," New York City, in discussing sabotage in water supply stated that attempted sabotage had been no myth and suggested State Sanitary Engineers become the leaders in preventing sabotage. Continued action with the F.B.I. seemed appropriate. Measures to cope with possible sabotage appeared to be not much more than might be considered desirable in adequately strengthening water supply systems.

In reply to the question—"What should a water works manager do, and how soon?"—Mr. Cleary stated that there was no blanket answer to the question. More should be done in connection with systems supplying important industrial areas and in this connection the advice and assistance of the F.B.I. might well be sought out as a justified request. However, in all cases plant visitors should be carefully scrutinized or visiting stopped entirely during the emergency. Fishing or recreational use in areas contiguous to dams should be stopped and important supply mains protected or guarded.

Colonel Schiedenhelm, who had served under Col. Longley in France as Lt. Col., 26th Engrs., praised his superior officer for getting water supply materials routed as next in importance to ammunition. He also praised the work of Major Leonard P. Wood (now with N. Y. City Board of Water Supply) in France. In modern high speed warfare it was his belief that Battalions would more or less have to take care of themselves because specialized service was less adaptable than in the 1914-18 affair.

Someone having raised the question as to what extent water systems of the London area had suffered

Officers, N. Y. Section AWWA
Wm. A. McCaffrey, Supt., Oswego, N. Y.
(A. W. W. A. Director)
Chas. R. Cox, San. Engr., Albany, N. Y.
(Chairman of the Section)
Rollo K. Blanchard, Neptune Meter Co. N. Y. C.
(Secy.-Treas. of the Section)

from air bombing, there seemed to be no one that knew. E. Sherman Chase, however, read from a letter written some time earlier by Chief Engineer Cronin of the London Metropolitan Supply. It stated that "Only a few small pipes had been broken so far, but a lot more is to be expected. It will prove interesting to see if preparations (London's) will successfully deal with the emergency." Mr. Chase remarked that you couldn't lick folk like that.

Since no one could answer the question of "How safe are dams against air bombardment?" it was proposed that a committee be set up to investigate and report on this important subject.

Norman J. Howard, of the Toronto Water Department and President of A.W.W.A., was present. He was asked to set forth precautionary measures taken in Canada. He stated that rather extensive plans had been made following the Munich Conference before war was declared, on advice of the Canadian Intelligence Service. Barbed wire enclosures had been put up, the plants flood-lighted and guards established. Plants could be entered only by visitors holding permits. This matter of maintaining guards had cost Toronto $180,000 the first 6 months and had been largely discontinued in consequence. Plans made involved having on hand important replacements and emergency repair equipment. Another important precautionary measure involved the secretion of plans of the system at several points to preclude their disappearance when most needed. Interlocking or adjacent municipal system seemed a justified measure along with an ample supply of emergency chlorination equipment and materials. London had, to his knowledge, at least one or two large mains hit by bombs.

H. S. Hutton, of W. & T. Co., revealed that chlorinator orders had indicated 25 new installations in the London system, but he had no knowledge as to where or why.

Superintendents' Session

(Harold W. Griswold Presiding)

"Cathodic Protection for Milford Standpipe" by H. M. Goff, Sup't. Milford Water Co., Milford Conn.

Mr. Goff first briefly explained the principle of Cathodic Protection of tanks and water towers and the equipment involved and commented on its interest to water operators as a method of submerged steel protection more economical than painting and by far more convenient. He referred his listeners to the splendid exposition of the method which appears in an article by Earl E. Norman, Supt. of Utilities, Kala-

A. W. W. A. Guests
H. E. Jordan, Exec. Secy., New York
M. F. Tiernan, Pres., W. & T. Co., Newark
E. F. Dugger, Mg'r. of Water Works, Newport News, Va.

mazoo, Mich., in the August, 1940, issue of the Journal of A.W.W.A.

The equipment being installed is the 85 foot high 48 foot diam. standpipe at Milford involves the use of special stainless steel electrodes.

The novel feature of the installation (the first of its kind) involves support of the 30 foot long electrodes (6 in number) from below rather than adaptation of suspended electrodes, interfered with by ice. Although the under water support-

ing scheme was more costly by $500 than the suspended electrode scheme it had been selected. Another interesting aspect was that electrodes 30 feet long were to be used in a standpipe 85 feet deep. Since the installation had not been completed no operating cost data could be cited, but current consumption costs had been estimated at $20.00 per year at a rather high power rate. The completed installation would cost $1,400 whereas a suspended electrode installation would have been $900.

S. S. Anthony (Supt., Augusta, Me.), reported that they had installed cathodic protection in a 300,000 tank 42 feet diameter and 30 feet deep. Graphite electrodes suspended 14 inches from the tank walls had been used. They planned on removing the electrodes in winter and rather expected the ice cylinder around the tank walls to protect the steel shell in winter.

Robert Spurr Weston (Boston) cited the installation at the Woodall Worsted Co. plant for the purpose of protecting the shell and underdrains of pressure filters. In service since July 1, an inspection August 24th had revealed stopping of tuberculation and the old scale had started to come away from the walls. The matter of protecting filter underdrains was especially interesting.

A question was raised concerning the likelihood that leaks would appear at the rivets and seams if the rust disappeared at such weak spots. The opinion given by F. M. Tobin, of the Electric Rustproofing Corp., Dayton, Ohio, was that some leakage might be expected when the rust was reduced by the current flow.

L. H. Enslow suggested that in connection with application of the Cathodic system to very soft waters and badly tuberculated tanks it sounded advisable to add lime to the water in some degree and for a period of a few months, after which the lime might be reduced considerably or discontinued. As he reasoned it, the lime would have a dual function. It would add conductivity to the water and render the scheme more positive and less expensive in current required. Secondly, since the current travels more pronouncedly to bare exposed metal and where the rust coating is the thinnest the calcium would be rapidly deposited at such weak points to more quickly heal the pit wounds and stop the leaks due to the formation of the desirable calcite ($CaCO_3$) film at these points. It had been observed that current costs were always highest in the early stages of cathodic protection applied to old tanks. It was the thought that since hard waters proved more desirable than very soft water that lime addition to moderately harden and correct the corrosivity of soft waters would prove meritorious in the beginning.

Col. F. F. Longley
Vice Pres.
Lock Joint Pipe Co.
Ampere, N. J.
(For World War Water Service Boasts a D.S.C.)

Col. W. F. Rockwell, Pres.
Pittsburgh Equit. Meter Co.
Pittsburgh, Pa.
(President of the Water and Sewage Works Mfrg's. Assn.)

S. S. Anthony (Augusta, Me.), said that the lime addition suggestion of Mr. Enslow sounded meritorious. The Augusta water had for some time been treated with about 1 grain of lime per gallon as a corrosion remedy. It had been noted that very shortly starting the current flow inspection revealed a calcite coating had begun to form.

Asked if the cathodic system could be applied to steel penstocks, Mr. Tobin replied that it could be and that the scheme had many other potential applications in the water and sewage fields.

"Three Major Events in the Life of a Small Water Company" by H. T. Gidley, Treas. and Sup't., Fairhaven (Mass.) Water Co.

Mr. Gidley's paper proved to be mostly a recital of some major disasters experienced in operating the Fairhaven system and a historical review dating from 1888 and illustrated with lantern slides. The first calamity was the peculiar failure of a riveted iron (not steel) elevated tank in 1901. The second the experience of being burned out in 1925, but the fortunate saving of records in the steel safe. The third was the experience in 1933 of having a chimney destroyed by lightning. A fourth major event was the 1937 change over from electric and steam power to Diesel engine drive.

Jas. F. Sanborn, Cons. Engr., New York
Louis R. Howson, Cons. Engr., Chicago
Leonard Wood, Asst. Chief Engr., N. Y. (Board of Water Supply, City of New York)

"The Organization and Activities of the National Plumbing Laboratory" by M. W. Cowles, Hackensack Water Co., Hackensack, N. J.

Mr. Cowles explained the work of the National Plumbing Laboratory at Iowa University, under the direction of Dean Dawson. The major investigation had been that of testing devices employed or offered for prevention of back siphonage and the newer domestic plumbing equipment specifically designed to preclude back siphonage. Six devices had to date rated a full acceptance and 12 of the newer devices had been given provisional acceptance.

H. M. Goff, Supt., Milford (Conn.) Water Co.
H. T. Gidley, Supt., Fairhaven (Mass.) Water Co.
Hugh McLean, Comm. of Water, Holyoke, Mass.

Answering the pertinent question, "How can anyone insure the use of approved devices?", Mr. Cowles suggested that such would have to come through plumbing codes and Water Department insistence. The requirement should at least start with all new buildings.

H. T. Hotchkiss (Larchmont, N. Y.), raised a very pertinent point when he asked why were health authorities seemingly endeavoring to place the responsibility of eliminating hazards within buildings on the shoulders of water works managers. Certainly there were other agencies which might more correctly assume the police power of enforcing plumbing regulations.

P. S. Wilson (Glen Ridge, N. J.), raised another very pertinent question when he asked if the National Laboratory or any other agency was attempting to develop measures to reduce the inadequacy of piping installations on private or public property and thereby reduce the frequency of vacuum. The reply was that as a testing group the Council

could not go beyond equipment testing.

"Cooperation of Fire and Water Departments" by R. C. Dennett, Engr., Nat'l Board of Fire Underwriters, New York City.

Mr. Dennett said that the matter of making hydrant flow tests and rating such hydrants was of particular help to Fire Departments in addition to giving the Water Department a clear picture of where betterments were most needed on the system while some cities were almost continuously making such tests and surveys, hydrant yield information was lacking in the smaller municipalities. In this same connection an aid to Fire Departments was the supplying of maps showing location of hydrants and sizes of mains. Better than a single map two maps were preferable—one showing the smaller mains in bold lines and the larger mains in faint lines, and the second map the reverse.

Manufacturers

H. W. Thompson, Manager of Sales
Ludlow Valve Co., Troy, N. Y.
Herbert Ballantine, Chairman of the Board
Neptune Meter Co., N. Y. City
I. A. Rowe, General Manager
Rensselaer Valve Co., Troy N. Y.

In addition to the helpful marking of fire hydrants or paint color scheme revealing the main size and yield of hydrants, now practiced in many cities, Mr. Dinnett suggested that some distinctive marking or color arrangement be used on the next to the last hydrant on dead ended mains. Thereby the fire fighters would know that there was one more hydrant on the line further out. If Water Departments would notify the Fire Chief whenever a defective hydrant is discovered or a main is to be cut-out for any purpose, and for how long, such information might prove very valuable.

(1) J. M. Diven, Jr., The Leadite Co., Philadelphia; (2) Henry D. Darrow, Supt. of Water, Kingston, N. Y.; (3) J. A. Frank, Engr., Nat'l. Water Main Clearing Co., N. Y. City; (4) Wm. T. Barry, Supt. of Water, Holyoke, Mass.; (5) Geo. L. Wirtz, Pres., Atlas Mineral Prod. Co., Mertztown, Pa.; (6) G. H. Patton, Supt. of Water, Rockville Center, N. Y.; (7) N. J. Kenny, Pres., Nat'l. Meter Co., Brooklyn, N. Y.

In Fire Stations pressure gauges should be installed, preferably of the recording type and a representative of the Water Utility should respond to fire alarms, proceeding to the scene in the case of a second alarm if not the first.

In return the Fire Department's pumpers could frequently be pressed into emergency duty to assist Water Departments. He cited the service of pumping out flooded stations or cellars and pumping from one system into another, around serious main breaks, etc.

Roger W. Oakman (Supt., Needham, Mass.), agreed with Mr. Dennett concerning the value of hydrant yield surveys to the Water Utility as well as the Fire Dept. and reported that on his small system such a survey had just been completed covering hydrants at 60 points. Also a map produced for the record and Fire Dept. use showed the hydrant ratings and main sizes.

Don C. Calderwood (Engr. Nashua, N. H., Water Co.), stated that they had been successful in getting Fire Department personnel to be present at many hydrant flow tests to demonstrate the fire flow which could be expected from the more important hydrants. Nothing gave so much confidence as an actual demonstration.

Harry U. Fuller (Chief Engr., Portland, Me., Water District) was requested by the chair to give his experiences. Mr. Fuller stated that the Water District supplied 16 different municipalities, that the District had gone as far as Fire Departments allowed. Maps had been prepared and supplied several of the towns served and limitations in hydrant yields had been shown each. On the Portland system program reducing deficiencies had reached a point now where it cost the Water District or city about $2,000 a point of rating whereas improvements in the Fire Dept. cost about $50 per point. Under the circumstances it was more feasible to work in the direction of strengthening the Fire Dept. rather than spend more on the water system for the present. It was a case of spending the dollar where it went the farthest.

Hugh McLean (Water Board Chairman, Holyoke, Mass.) asked for advice as to what could be done to correct a situation wherein the lawn sprinkling load depleted pressures in Holyoke to a serious extent should a fire develop at the time. He said that the city had an abundance of water and an all gravity system. Except for the larger consumers they didn't need meters. Enforcing restricted sprinkling seemed the only answer.

Mr. Dennett replied that in many instances sprinkling and other peak loads exceeded the maximum fire requirement. To correct this situation elevated storage, or ground storage and booster pumping had proved the one best solution of the problem. In other cases additional main capacity had been the solution.

Richard Ellis (Factory Mutual Fire Ins. Co.) said that Holyoke with abundant water, one of the very lowest non-metered rates and per capita consumption of 175 gal./day

(1) "Bob" (R. W.) Turner, Mgr. N. Y. Office, Rensselaer Valve Co.; (2) Geo. Carpenter, Supt. Water and Sewerage, Ithaca, N. Y.; (3) C. A. McHugh, Contractor, Philadelphia (Probably holds a record for mileage of C. I. Pipe laid); (4) John Muddiman, Chemist, Kingston, N. Y.; (5) Fred J. Reny, Gen'l. Mgr. and Treas., Portland (Me.) Water District; (6) Wm. Naylor, Supt. and Registrar, Water and Sewerage, Maynard, Mass.; (7) F. M. Tobin, Electro Rustproofing Corp'n., Dayton, O.; (8) "Bob" (R. E.) Ferguson, Hersey Meter Co., Boston.

could secure relief by providing elevated storage followed later by larger mains if required as long as metering would not be tolerated by the taxpayers and the supply proved ample as it seemed to be.

Harry U. Fuller, in commenting on this and similar situations, said that he considered it the first duty of the water works manager to give consumers the service desired as long as there was willingness to pay, and not institute restrictions until such proved the last way out. However, in some cases the restriction method is the quickest way in which conditions can be impressed on the public —that is, unless a serious fire should come along to do the job of proving the need for spending money on the system.

[Taking into consideration all statements made by Mr. McLean and answers to questions, it seemed apparent that something in the nature of distributed storage was the first consideration in solving the Holyoke problem.—Ed.]

"Promoting Tax-Payer Interest in Water Supply" by C. Schwarzler, The Foxboro Co., Foxboro, Mass.

In his travels Mr. Schwarzler has observed both good and bad water works publicity and his paper contained many pointers of worth as a guide to securing more local recognition of water utilities. His first reminder to water works managers is that they have something to sell, either the commodity — water — or service. They might well consider themselves as manufacturers and sellers of something for which there is no substitute. In this day the product must first of all be of high grade. Even if funds were available straight advertising would not suffice, and fortunately other publicity methods were available at relatively little cost. These should be put to the fullest use.

As the very first step in getting the "Water Works House" in order for building better public relations and telling the taxpayer about the

E. J. Cleary, Assoc. Editor
Eng. News Record, New York
E. T. Cranch, Manager
New Rochelle (N. Y.) Water Co.
Wm. P. Melley, Supt. of Water
Milton, Mass.

water supply service, is employee education. That is, the employee must be given enough information and schooling to encourage interest in his job and give intelligent answers to the public. It goes without saying that the office should be neat and clean—i.e., in harmony with the purity of the product dispensed. The same reasoning applies to the "factory"—the purification plant and pumping stations. Then after the plant is put in first class order and brightened up, if there are any signs on the property such as this one— "Positively No Admittance or Trespassing — Waterworks Property" — tear them down and put up an inviting sign. If a warning against pos-

Richard H. Ellis, Engineer
Factory Mutual Fire Ins. Cos.,
Boston
(Chairman, Comm. on Meter
Specifications)
Karl R. Kennison, Chief Engr.
Metro. Water Supply Commission, Boston
Thos. H. Wiggin, Consulting Engr.
New York City

sible pollution is necessary state it in a pleasant manner, try never to "Forbid." Then there is the matter of the Complaint Department which certainly must be courteous even though firm.

After all the above considerations, said Mr. Schwarzler, apply to every business which today is to enjoy good public relations and success and until you have produced something from the inside worthy of "selling" don't try to sell it. That also applies to every business. Now with the house in order—so to speak—the next move can be undertaken.

In the smaller towns and cities under 150,000 your best friend can well be the local newspaper publisher or editor. Develop an intelligent interest here and the results will speak for themselves. Whatever the water works can offer of news value will become welcome for printing and an occasional editorial comment may appear. When the Health Department renders a favorable report it should make good reading in the local paper, reassuring the public of its water quality. Then, too, many brief messages can be circulated in the form of inserts, with bills or stickers attached, and here, also, is a spot for good reports on water quality, fire service ratings, improved pressures, cleaned mains, etc. Don't underestimate the interest that the consumer may have in these betterments and undertakings.

In attracting visitors to the plant picnic grounds have been effectively used, but sidestep the playground idea. Make of your plant a beauty spot by putting in fountains or lily ponds and planting the grounds for beautification. Spend the necessary money as a profit yielding investment—the profit being public interest and good will when it comes to voting bond issues.

In the matter of water plant design a leaf might be taken from the radio world where the public may look through glass partitions and see the wheels go round without the danger of getting caught in any of them. And the scheme of central control panels and tables are as attractive to visitors, who may see valve pilot lights flash and others travel as the water does, as they are serviceable in improving or simplifying plant operation.

GASCOIGNE FIRM REORGANIZED

Now Havens and Emerson, Engineers

In consequence of the death of George B. Gascoigne, Gascoigne and Associates have been reorganized by the formation of a partnership under the name of Havens and Emerson.

The members of the new firm are William L. Havens, Charles A. Emerson, Alfred A. Burger, Frank C. Tolles, and Frank W. Jones, comprising all of the associates of the former organization.

The present offices in the Leader Building, Cleveland, and in the Woolworth Building, New York City, will be maintained.

Mr. Havens, following six years' service as Assistant Engineer in the Division of Sewage Disposal, Cleveland, Ohio, was associated with Mr. Gascoigne since 1922 in a responsible capacity. Mr. Emerson, former Chief Engineer of the Pa. State Dept. of Health, was for thirteen years in private practice as an associate in the Fuller & McClintock organization, and with Mrs. Gascoigne for the past four years in charge of the New York office.

Messrs. Burger, Tolles and Jones have been associated with the organization for 18, 15 and 17 years, respectively.

THE BIOFILTRATION SYSTEM*

A Flexible Means of Varying the Degree of Sewage Treatment

By ANTHONY J. FISCHER, Ph.D.†
THE DORR COMPANY, INC.
NEW YORK, N. Y.

Introduction

UP TO about five years ago the activated sludge process was increasing in favor over trickling filter treatment, even for small plants. This trend developed in the face of the generally recognized fact that the activated sludge process does not readily withstand sudden shock loads such as from creamery, laundry and other wastes that are in a large measure responsible for poor performance and sludge bulking in the average small plant.

A number of reasons contributed this general trend, not the least of which was the greater potential flexibility obtainable in activated sludge plants where it proved possible to vary the volume and distribution of air and regulate sludge return in accordance with the load requirements. The higher degree of treatment possible in the activated sludge process, when all was working well was also a prime consideration.

The standard trickling filter plant, on the other hand, was usually designed with a six-foot stone depth to settled sewage was applied at an average rate of about 2.0 million gallons per acre per day—hereafter referred to as m.g.a.d. It was generally accepted that about 75% of the applied 5 day oxygen demand (hereafter referred to as B.O.D.) would be removed in the filter and that, therefore, the quality of the effluent would vary with the strength of the applied sewage. It was also assumed that the beds would slough twice a year, and that clogging and ponding would occur between time if the filter dosing exceeded much over 4.0 m.g.a.d. Filter flies were taken as an inherent nuisance, with provisions for flooding or chlorination considered essential to their control. Release odors was considered a likelihood unless pre-chlorination be provided for use if and when needed.

The Author

With the realization that the average small activated sludge plant could not take varying loadings with any degree of success, usually requiring frequent use of the plant by-pass, came the intensive study of methods of more adequate control of the trickling filter and its operation. An outcome of this work was the development of the so-called "high-rate" filter (more properly defined as the "high-load" filter) one form of which is used in the Biofiltration System.

Biofiltration System

In the Biofiltration System there are two important considerations—one involving the minimum dose applied to the filter, the other involving the recirculation of filter discharge material back to a settling or detention tank preceding the filter.

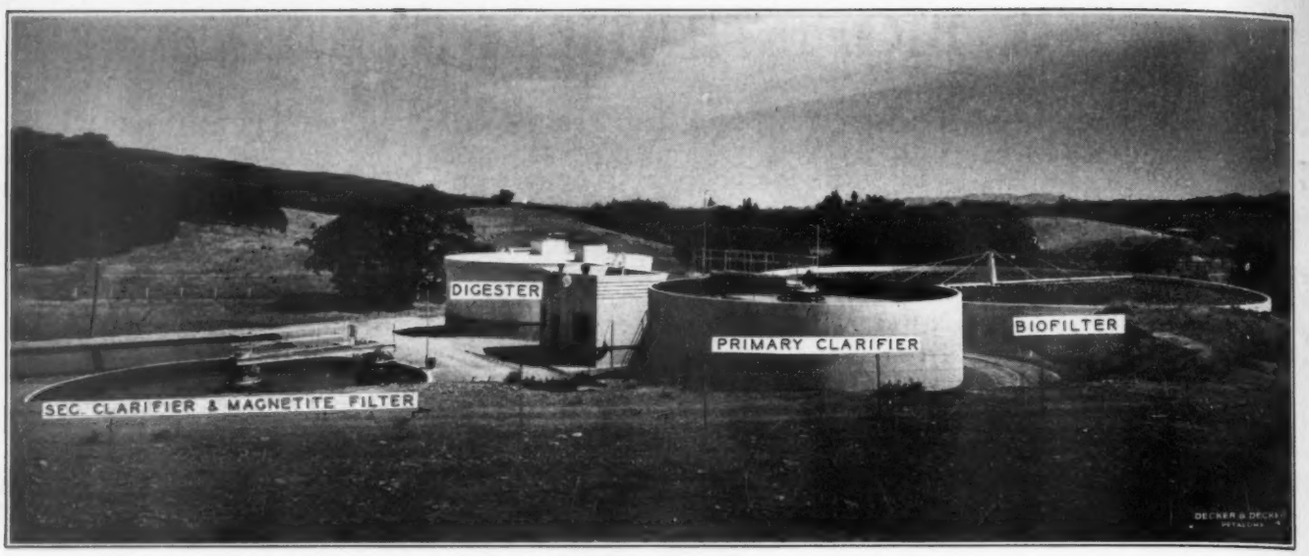
Characteristic, but not all necessarily essential, elements of the process involve:

(1) Presedimentation of the sewage before it is applied to the filter;
(2) The use of dosing rates on the filter *in excess of* 800 gallons per cu. yd. of filter medium;
(3) Clarification of the filter effluent in either the detention tank preceding the filter or in a separate clarifier;
(4) Recirculation of filter effluent, final clarifier effluent, or final

*This paper written for publication in "Water Works and Sewerage," was read before the 14th Annual Conference of The Maryland-Delaware Water and Sewage Association, Salisbury, Md., May 16, 1940. —Ed. †Development Department.

The Two Stage Biofilter Plant of Covina, California

The Secondary Effluent Is Chemically Flocculated and Clarified in a Clariflocculator. The Final Effluent Passes Through Sand Filters.



The Single Stage Biofilter Plant of Sanoma, California
The Secondary Effluent Is Rendered More Attractive by Passage Through a Magnetite Filter.

clarifier sludge, back to the new incoming feed;

(5) The use of filter beds having stone depths *as low as* three feet;

(6) The use of two-stage treatment where very strong sewages are encountered, or where a high degree of treatment is desired;

(7) Average daily filter loadings based on raw sewage *as high as* 5.0 pounds of B.O.D. per cu. yd. of filter medium;

(8) Substantially continuous filter dosing.

Action of Process

The continuous passage of the sewage and recirculated effluent through the system at a relatively high rate causes a uniform action to take place throughout the entire filter bed depth. Also, the surface of the filter is kept wet at all times, while the detention period in the settling or detention tank never becomes excessively long. This results in a uniform action throughout the filter bed depth, continuous filter bed unloading, prevention of surface ponding and filter fly breeding, and the prevention of septic action in the settling tank at times of low flow.

Because of the relatively short detention or contact period in the filter, complete stabilization is not secured in the filter alone. This unit rather acts as a "colloider" and serves to coagulate the colloidal material and agglomerate the very fine particles in the sewage in much the same way as is accomplished in chemical precipitation processes and to a considerable degree in the first stages of the activated sludge process. At the same time, however, there is an appreciable reduction in B.O.D. and a build-up of dissolved oxygen which is utilized to complete the stabilization in the detention tank. In this way the Biofiltration Process may be considered as the full equivalent of the activated sludge process, the filter being the source of oxygen and micro-organisms, and the clarifier or detention tank serving as the aeration tank as well as the settling unit.

Typical Flowsheets

Typical Biofiltration Process flowsheets involve the use of either single-stage or two-stage treatment as follows:

1. *Single-Stage (Intermediate) Treatment*

With this flowsheet (shown in Figure 1) an effluent having a quality between that of a primary treatment and a standard trickling filter may be obtained. With normal strength sewage (200-250 p.p.m. B.O.D.), a reduction of about 50% to 60% may be expected where the volume of recirculated flow is equal to at least twice the volume of the new feed to the system. Whether the final effluent should be taken off at the clarifier or the filter depends on the strength of the raw sewage and the recirculation ratio employed. With weak sewage and/or with high recirculation ratios, a better grade effluent may be obtained from the clarifier. With strong sewage and/or low recirculation ratios, the filter effluent should be better. This is illustrated by the plant operating results given in Table 1 for a strong and a medium sewage. It is observed that in the case of the first the clarifier effects no improvement, but rather the reverse.

2. *Single-Stage Complete Treatment.*

This flowsheet (shown in Figure 2) differs from that of Figure 1 in that the filter effluent is settled in a separate secondary clarifier before being discharged from the system. This flowsheet should produce results on a par with standard trickling filters. It should be noted that this flowsheet involves the return of filter discharge and/or secondary clarifier material. The secondary clarifier material may be effluent, sludge or any combination of the tank contents.

A popular modification of this flowsheet (see Figure 3) involves the recycling of part of the secondary clarifier to the filter while part of the filter effluent and all of the secondary sludge is recycled to the primary clarifier. With this arrangement both clarifiers may be of the same size and have the same detention and overflow rate.

With this flowsheet, overall B.O.D. reductions of 75 to 85% may be expected when a normal sewage is being treated and a recirculation ratio of about 2 is maintained. Typical results obtained from large-scale plant operation are shown in Table 2.

3. *Two-Stage Complete Treatment.*

Figure 4 shows three modifications of a two-stage complete treatment plant. These vary as to the point of take-off from the primary system and point of delivery to the secondary system. Flowsheet (a) is a preferred form from the standpoint of avoiding short-circuiting of primary settled sewage directly to the secondary filter. Actual operating results, however, indicate that regardless of this short-circuiting

around the primary filter in flowsheets (b) and (c) a final effluent low in B.O.D. may be obtained. Flowsheet (b) has certain advantages in arrangement of the plant structures with minimum interconnecting piping. This piping may be readily arranged to provide a maximum of plant flexibility at little additional cost. One such arrangement is shown in Figure 5-a where gravity flow cannot be obtained through the entire plant. Another, as shown in Figure 5-b, is suitable where sufficient head is available to carry the flow through all the plant structures without auxiliary pumping other than for recirculation. A plant of the latter type is now under construction at Liberty, N. Y. (This plant has since the writing of this article been placed in operation.—Ed.) Here the total head available from the primary clarifier inlet to the final clarifier overflow weir was only about 6 feet.

Many modifications of this two-stage treatment flowsheet are possible. For example, a separate clarifier may be used for primary settling, final effluent may be recirculated to the raw sewage, etc.

With a normal strength sewage and a recirculation ratio of 1 to 1 in each stage, this two-stage system should effect an overall reduction in B.O.D. of 90-95%, with the production of a well nitrified effluent, high in dissolved oxygen and low in suspended solid. In this respect this flowsheet may be regarded as producing results the full equivalent of the activated sludge process. Typical plant results are given in Table 3.

Factors Influencing Design and Operation

A study of these and experimental plant results indicate that the following are the most important factors that influence the design and operation of Biofiltration Systems.

(1) B.O.D. loading on the filter (expressed as lbs. B.O.D./cu. yd. of filter medi/day);

(2) Recirculation ratio (ratio of recirculated to new incoming flow);

(3) Clarifier detention and overflow rate.

Of secondary importance are dosing rates on the filter, method and continuity of application of the sewage to the filter, and design of the filter bed as to selection of filter media and provision for adequate ventilation. Within limits, the depth of the filter bed apparently has little effect, 6 to 8 foot beds giving little improvements over shallow beds 3 to 4 feet in depth.

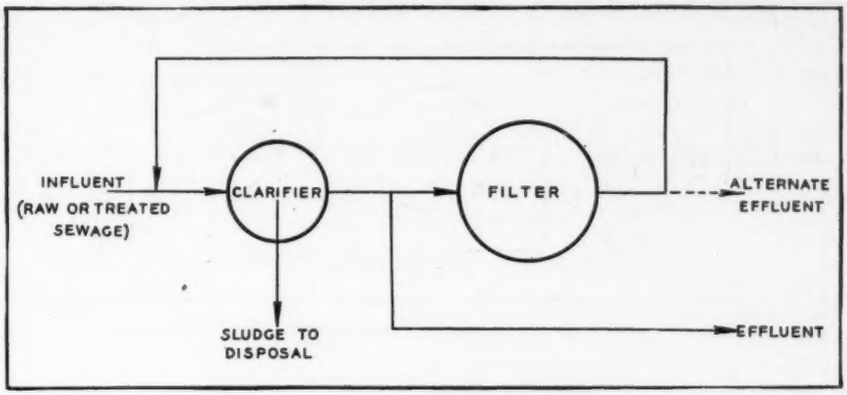


Fig. 1: Single Stage Intermediate Treatment

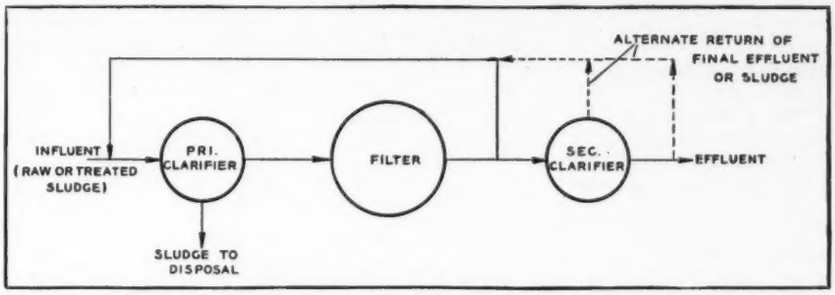


Fig. 2: Single Stage Complete Treatment

TABLE I

Relative Quality of Primary Filter and Detention Tank Effluent with Weak and Strong Sewage—Single-Stage Intermediate Treatment

	Petaluma, Calif.	*Healdsburg, Calif.*
Suspended Solids—ppm		
Raw Sewage	394	200
Clarifier Effl.	126	69
Filter Effl.	132	120
B. O. D.—ppm		
Raw Sewage	636	304
Clarifier Effl.	257	87
Filter Effl.	216	125
Per cent Removal		
Sus. Solids—Clarifier	68.0	65.5
—Filter	66.5	40.0
B. O. D.—Clarifier	59.6	71.4
—Filter	66.0	58.9
Dosing Rate—M.G.A.D.—Raw	5.0	8.0
Dosing Rate—M.A.G.D.—Total	19.5	49.0
Recirculation Ratio	2.9	5.1
Aver. Raw B.O.D. Loading—#BOD/c.y./day	5.38	3.99
Clarifier O'flow Rate—Gals./sq. ft./24 hrs.	1170	1120

TABLE 2

Single-Stage Complete Treatment—Plant Results

	Petaluma, California	*Camarillo,* California*	*San Mateo, California*	
Suspended Solids—p.p.m.				
Raw Sewage	437	223	201	233
Primary Clar. Effluent	167	78	157	80
Final Clar. Effluent	48	22	60	33
Primary Removal—Per cent	61.8	65.0	21.8	65.7
Total Removal—Per cent	89.0	90.0	70.1	85.8
B.O.D.—p.p.m.				
Raw Sewage	644	285	231	238
Primary Clar. Effluent	419	127	131	143
Final Clar. Effluent	53	26	45	16
Primary Removal—Per cent	35.0	55.4	43.3	40.0
Total Removal—Per cent	91.8	91.0	80.5	93.3
Dosing Rate—MGAD—Raw	4.90	5.33	19.0	10.2
Dosing Rate—MGAD—Total	17.2	27.8	69.5	38.4
Recirculation Ratio	2 50	4.2	2.65	2.76
Aver. Raw Loading—#BOD/cy/day	5.35	2.60	7.57	4.17
Aver. Settled Loading—#BOD/cy/day	3.48	1.16	4.30	2.50

*State Hospital Plant.

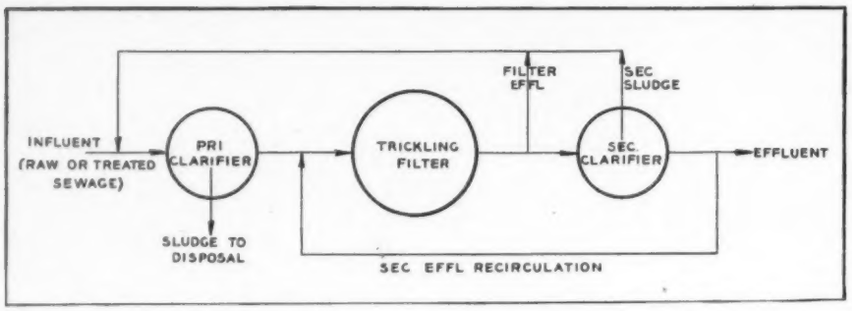


Fig. 3: Single Stage Complete Treatment Modified Flowsheet

TABLE 3

Two-Stage Complete Treatment—Plant Results

	Petaluma, Calif.		*San Mateo, Calif.*		*Healdsburg, Calif.*
Suspended Solids—p.p.m.					
Raw Sewage	394	462	233	201	249
Primary Effluent	126	150	33	60	64
Final Effluent	38	43	30	17	29
Primary Removal—Per cent	68.0	67.5	85.8	70.2	74.3
Total Removal—Per cent	90.3	90.7	87.1	91.5	88.2
B.O.D.—p.p.m.					
Raw Sewage—p.p.m.	636	521	238	231	395
Primary Effluent	257	333	16	45	84
Final Effluent	33	28	13	13	27
Primary Removal—Per cent	59.6	36.0	93.2	80.5	78.7
Total Removal—Per cent	94.8	94.6	94.6	94.3	93.2
Dosing Rate—MGAD—Raw	5.0	10.6	10.2	19.0	7.90
Dosing Rate—MGAD—Total	19.5	37.1	38.4	69.4	49.0
Recirculation Ratio	2.90	2.50	2.76	2.65	5.19
Aver. Raw Loading—#BOD/cy/day	2.69	4 78	2.08	3.78	2.53

B.O.D. Loadings

The capacity of a filter for removing B.O.D. is not yet fully understood. Results obtained to date (shown in Figure 6) indicate that the strength and character of the raw sewage is a determining factor. These average curves show that with increasing sewage strength a greater amount of B.O.D. may be removed per unit of volume of filter medium. They also show that with a given strength of sewage the overall removals increase up to a certain point, after which there is no further reduction regardless of the increase in loading. A very interesting feature is, however, that the capacity for B.O.D. removal does not fall off as the result of the super-loadings.

Where much stronger sewage or trade wastes are treated, such as creamery, cannery, beet sugar, distillery waste, etc., much higher B.O.D. removals may be obtained. For example, B.O.D. removals as high as 5.23 lbs./cu. yd./day were obtained when treating beet sugar waste having a raw B.O.D. of 1,650 p.p.m.. Also in the case of a distillery waste having a B.O.D. of 20,000 p.p.m., such phenomal removals as 15.4 lbs./cu. yd./day were obtained.

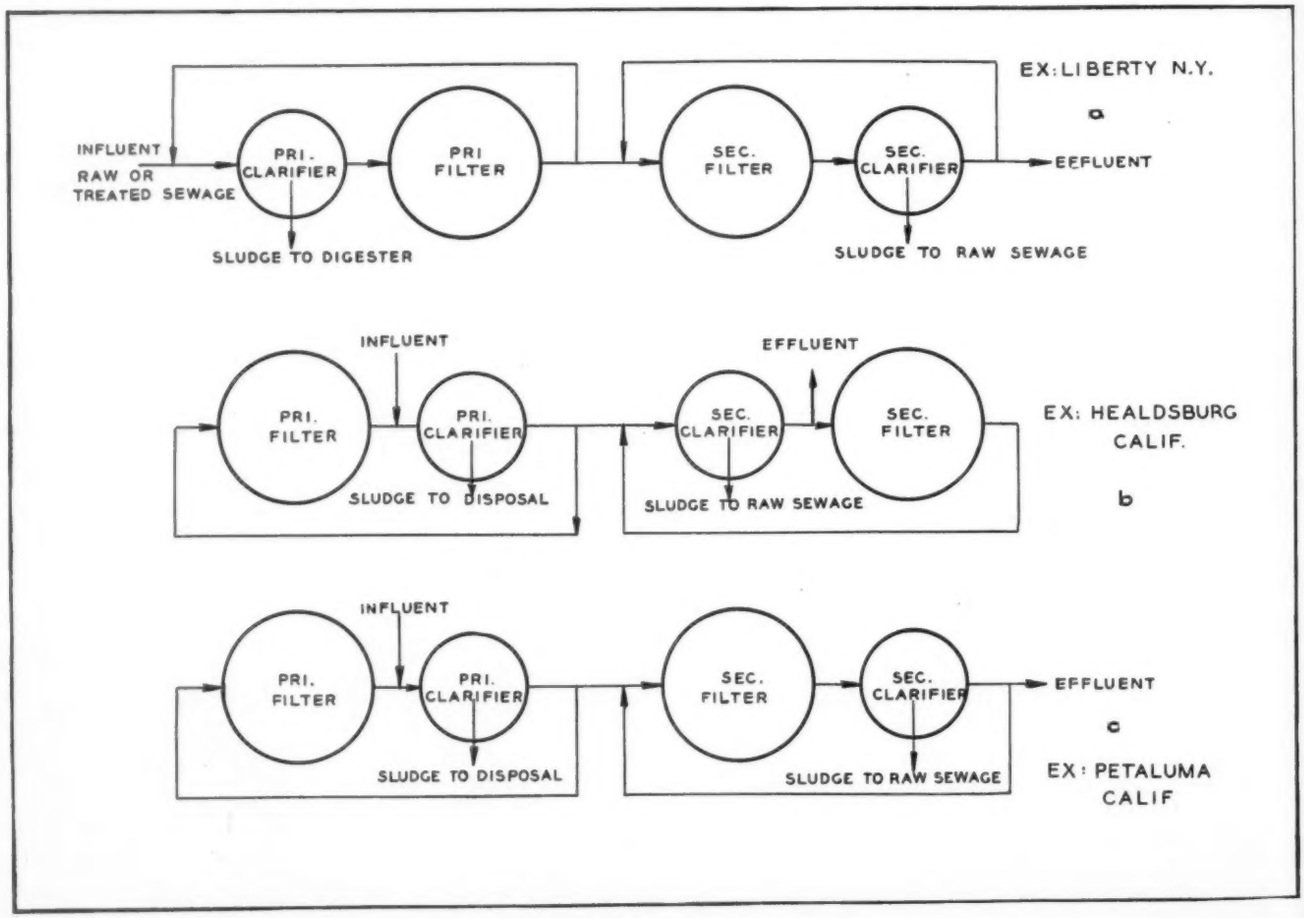


Fig. 4: Two-Stage Complete Treatment

TABLE 4

Results of Biofiltration vs. Standard Trickling Filter Treatment

	Petaluma, Calif. Single-Stage Complete Treatment		*Healdsburg, Calif. Single-Stage Intermediate Treatment*	
	(Biofilter)	(Std. Filter)	(Biofilter)	(Std. Filter)
Suspended Solids—p.p.m.				
Raw Sewage	437	410	269	244
Primary Effluent	167	170	64	102
Final Effluent	48	85	..	49
Primary Removal—Per cent	61.8	58.6	76.1	58.2
Total Removal—Per cent	89.0	79.3	76.1	79.8
B.O.D—p.p.m.				
Raw Sewage	644	640	395	390
Primary Effluent	419	455	84	285
Final Effluent	53	166	..	115
Primary Removal—Per cent	35.0	29.0	78.7	26.9
Total Removal—Per cent	91.8	74.1	78.7	70.5
Dosing Rate—MGAD—Raw	4.90	4.83	7.9	8.2
Dosing Rate—MGAD—Total	17.15	4.83	49.0	8.2
Recirculation Ratio	2.5	0	5.2	0
Aver. Raw Loading—#BOD/cy/day	5.35	5.25	5.27	5.40
Aver. Settled Loading—#BOD/cy/day	3.48	3.73	1.12	3.94
Clarifier Overflow Rate Gals./sq. ft./24 hrs	1095	252	1120	187

TABLE 5

Minimum Recirculation Ratios for Various Strengths of Sewage

B.O.D.—Raw Sewage	*Recirculation Ratio (Recirculated Flow) Raw Sewage Flow* Single-Stage Intermediate Treatment	Single-Stage Complete Treatment	Two-Stage Treatment (Each Stage)
Up to 150 p.p.m.	1.0	0.75	0.5
150-300 p.p.m	2.0	1.5	1.0
300-450 p.p.m.	3.0	2.25	1.5
450-600 p.p.m.	4.0	3.0	2.0
600-750 p.p.m.	5.0	3.75	2.5
750-900 p.p.m.	6.0	4.5	3.0

TABLE 6

Relative B. O. D. Removals by Filter and Post-Settling at Various Filter Dosing Rates (Levine)

Dosing Rate M.G.A.D.	*Lbs. B.O.D. Removed Per Cu. Yd. of Filter Medium* Filter Only	Post-Settling	Total	*Per cent Removed by** Filter	Post-Settling
2.0	0.235 +	0.049 =	0.284	83.0	17.0
4.0	0.344 +	0.145 =	0.489	70.4	29.6
8.0	0.572 +	0.457 =	1.029	55.2	44.8
16.0	1.53 +	1.25 =	2.78	55.1	44.9

*Figures represent per cent of total B.O.D. removed for which each unit was responsible.

TABLE 7

Biofiltration System—Clarifier Design

	Single-Stage Treatment Intermediate	Complete	*Two-Stage Treatment*
Primary Clarifier			
O'flow rate—gals./sq. ft./24 hrs.	800-1000	1200-1500	1200-1500
Detention—Hrs.	2.0	1.5	1.5
Secondary Clarifier			
O'flow rate—gals./sq. ft./24 hrs.	.....	800-1000	1200-1500
Detention—Hrs.	.....	1.5	1.5

TABLE 8

Test Results on Single-Stage Biofilter System, Experimental Unit

	Test 1	*Test 2*	*Test 3*
Filter Depth	6 ft.	4 ft.	2 ft.
Raw Dosing Rate—M.G.A.D.	12.0	12.0	12.0
Total Dosing Rate—M.G.A.D.	60.0	60.0	60.0
Recirculation Ratio	4.0	4.0	4.0
Suspended Solids—P.P.M.			
Raw Sewage	315	293	288
Primary Clar. Effluent	160	133	147
Final Clar. Effluent	46	58	57
Primary Removal—Per Cent	49.3	54.6	49.0
Total Removal—Per cent	85.4	80.2	80.2
R.O.D.'s—P.P.M.			
Raw Sewage	233	268	273
Primary Clar. Effluent	165	205	179
Final Clar. Effluent	63	52	67
Primary Removal—Per cent	29.2	23.5	34.5
Total Removal—Per cent	83.0	80.6	75.5
Raw Loading No. B.O.D./c.v./day	2.40	4.15	8.45
Dissolved Oxygen—Final Eff.	4.5	4.0	2.9

The data of Figure 6 are based on 24-hour samples composited according to flow. Tests on catch samples collected at times of peak sewage flow (and/or strength) showed that peak B.O.D. loadings of about three to four times the daily average may be successfully handled.

Recirculation

That recirculation is of distinctive advantage is shown by the data given in Table 4, where Biofilter single-stage complete and intermediate operation are compared to standard trickling filter results, where the B.O.D. loadings were essentially the same.

Normally a plant design should allow for *minimum* recirculation ratios given in Table 5. For stronger sewages, proportionately higher ratios should be used. With all types of plants, *the higher the recirculation ratio, the better the overall results obtained.*

Clarifier Design

That the clarifier following a filter becomes increasingly more important as the dosing rate on the filter is increased has been shown by Levine. Using a 6-ft. deep filter, he found the results given in Table 6. In these tests the material (milk waste) was passed through the filter only once. A similar trend is followed, however, when recirculation is employed.

As in the case of the activated sludge process, clarifiers in Biofilter plants should be rated on overflow rates as well as on detention period. The former is by far the most important factor. Table 7 shows the preferred basis of design for the various types of plants. Both overflow rates and detentions should be based on the total flow to the clarifiers, including the recirculated flow. In general, within limits the greater the recirculation ratio the higher are the overflow rates and the lower are the detention periods that may be used without adversely affecting results.

Dosing Rates

Provided the dosing rate on the filter does not fall below about 4 to 8 m.g.a.d. and does not exceed about 100 to 125 m.g.a.d., this factor appears to have very little effect on Biofilter operation. The purpose of maintaining more than the lower rate is to aid in preventing the accumulation of solids in the filter bed.

Another object is to keep the surface wetted more or less continuously, and so prevent the propagation of filter flies. The maximum rate must not be exceeded; otherwise the filter bed will be flooded.

Filter Bed Design

Most Biofilter plans now in operation or under construction use filter beds having a 3-ft. depth of filter medium. As in the case of conventional low rate filters, tests have shown that an increase in filter depth improves the B.O.D. reduction but slightly. This is shown by the experimental data given in Table 8.

Crushed stone 1½″ to 2½″ in size has been used in primary filter beds, while ¾″ to 1″ stone has been found satisfactory for secondary beds in warm climates. For average conditions, however, it is felt that 2″ to 3½″ and 1½″ to 2½″ stone would be better in the primary and secondary units respectively.

The filter media should be supported on a grid or underdrain system that will allow a free get-away of filter effluent so that good natural ventilation is obtained. It is questionable whether artificial ventilation would ever be required, especially where shallow beds are used.

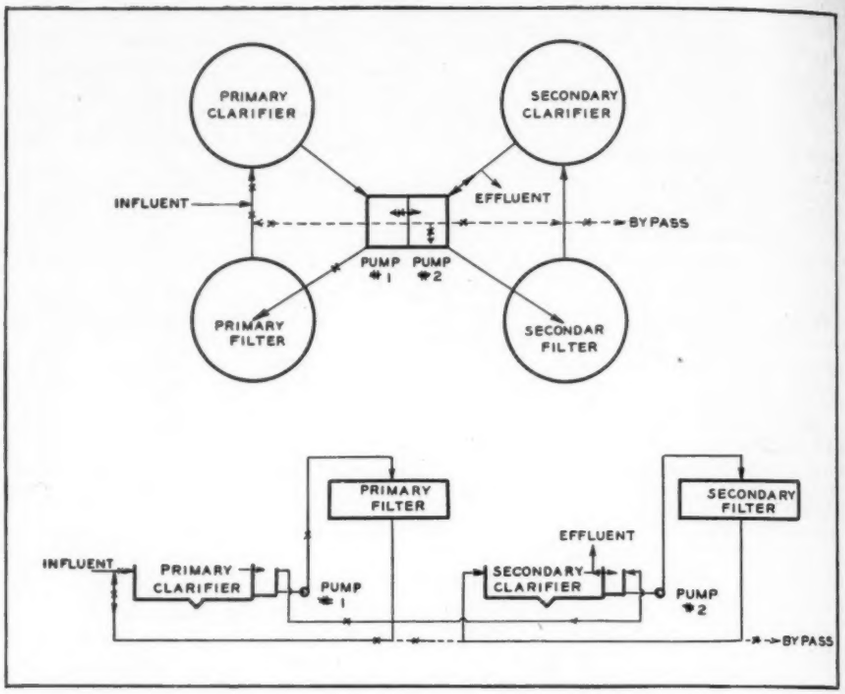
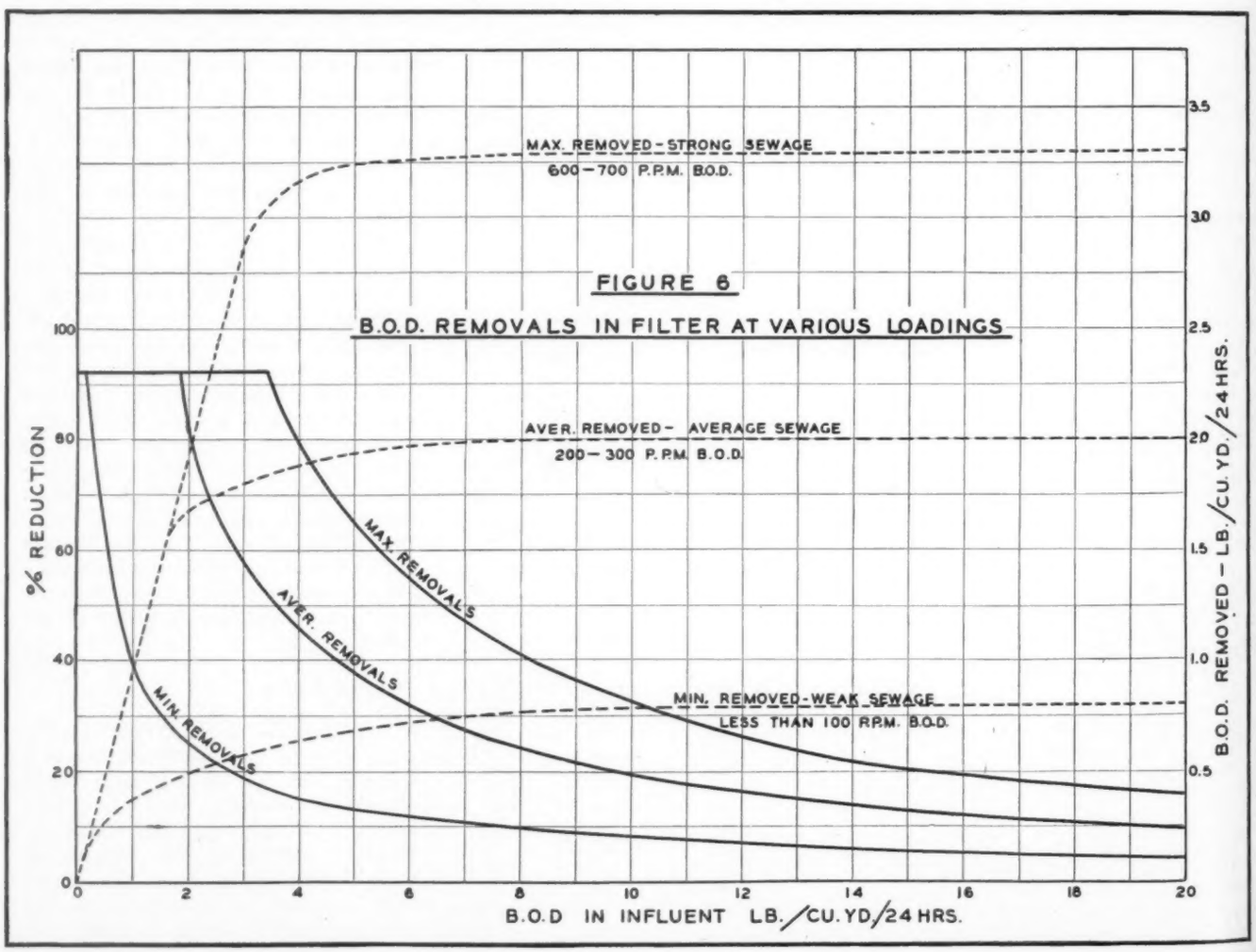


Fig. 5[2]: Two-Stage Flowsheet Clarifier Effluents Pumped to Filters



Distributor

To take care of the high rates of application used in connection with the Biofiltration Process, special types of distributors have been developed to operate at heads as low as 18″ to 24″ above the stone surface. Where the flow fluctuation is considerable (over 3:1), the arms have two compartments, one above the other. The bottom compartments are designed to handle any desired proportion of the maximum design flow, quantities in excess of this being taken by the top compartments. Details of the mechanism construction are shown in Figure 7.

Field of Application

Considering the flexibility in design and operation as shown by the foregoing data, the Biofiltration System may be applied to the treatment of sewage and trade waste ranging from weak domestic sewage to strong industrial wastes, with the reduction in B.O.D. normally ranging from 50% to 95%. It is particularly adaptable to such cases where a municipal sewage treatment plant receives occasional or seasonal loads of industrial wastes such as from packing houses, dairies, textile mills, canneries, etc. Another application is for partial pre-treatment of industrial wastes before they are discharged to the city sewers. In this connection some test data on distillery waste treatment as shown in Table 9 are of interest. In Test 1 the standard two-stage Biofiltration was used, while in Test 2 the filter effluents were recycled back to the filters rather than to the detention tanks. In Test 3, the primary filter effluent was applied directly to the secondary filter instead of back to the primary detention unit. The effect of this was to give a single-stage filter 6 ft. deep. In Test 4 no recirculation was used, but each filter effluent was settled. It will be noted that these results confirm those obtained on weaker sewage in that recirculation is shown to be of decided advantage, better results being obtained when the filter effluent is recycled back to the detention tank. The results also show that a 3-ft. depth of filter medium accomplishes almost the same reduction in B.O.D. as does a 6-ft. depth. It was found in these tests that although the pH values of the feed were very low, it was not necessary to add any neutralizing agents provided the B.O.D. loading capacity of the filters was not exceeded. This filter loading capacity varied, depending on the flow-

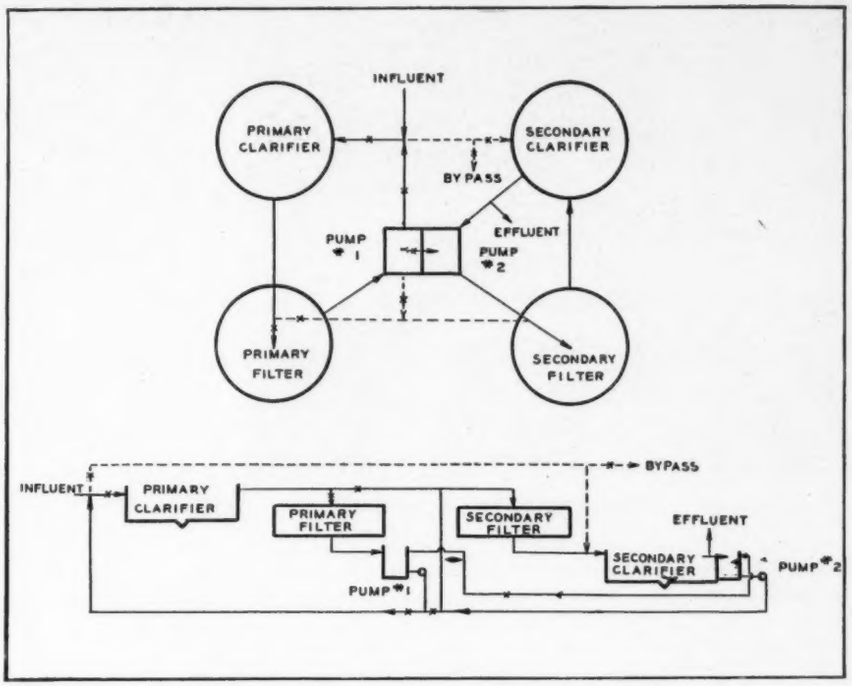
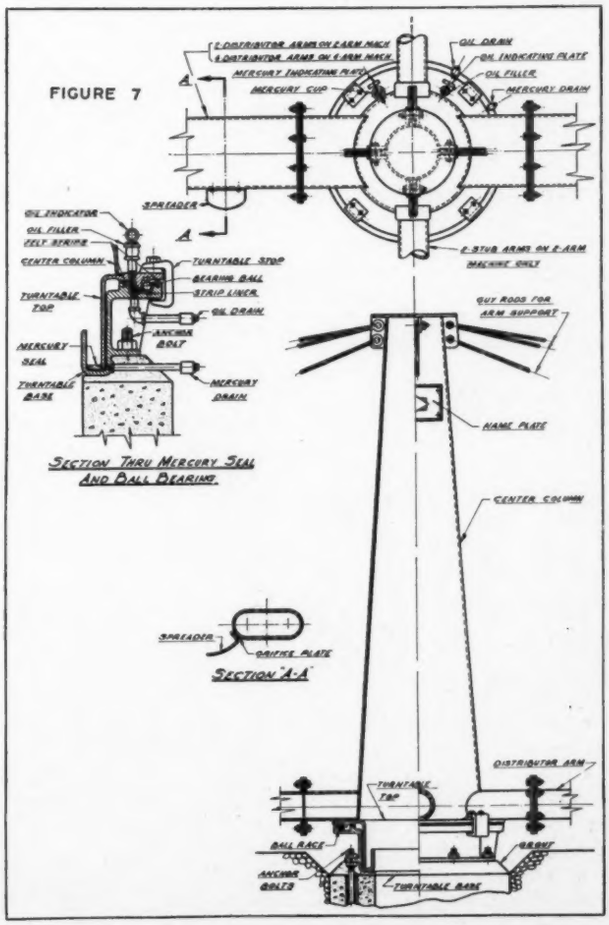
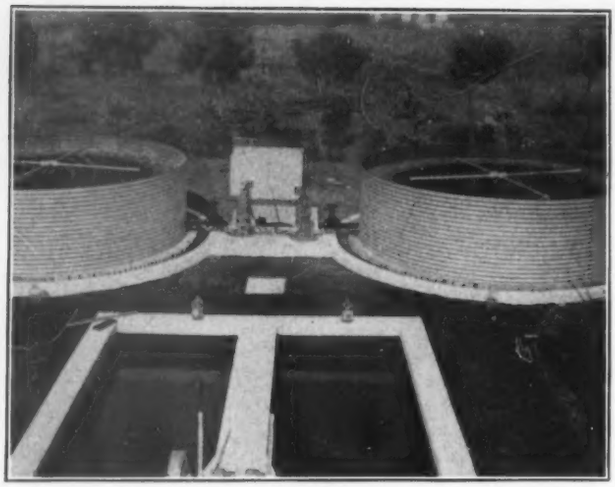


Fig. 5[b]: Two-Stage Flowsheet Gravity Flow Thru Plant

sheet employed. In the regular Biofilter flowsheet the primary filter was capable of handling a raw B.O.D. load of 18 to 20 lbs./cu. yd./day. This phenomenally high loading has hitherto never been obtainable in trickling filter operation. It indicates that with adequate control facilities and with a rational basis of design, trickling filters as applied in



Construction Details of Distributor Mechanism



Two-Stage Biofilter Plant of San Mateo, California.

the Biofiltration System are capable of satisfactorily treating sewage or trade wastes under an extremely wide variety of conditions.

Conclusions

1. The degree of treatment of sewage may be varied over a wide range by the use of the Biofiltration System.

2. The single-stage process in which one filter and one clarifier is used, will effect B.O.D. reductions of 50-60%.

3. The single-stage complete system, using one filter and two clarifiers, will give B.O.D. reductions of 75-80%.

4. In the two-stage system where two filters and two clarifiers are used, B.O.D. reductions of 90-95% may be effected.

5. The chief factors that influence the design and operation of all types Biofilter plants are B.O.D. loading on the filter, the volume of recirculated flow, and the clarifier overflow rate and detention.

6. The capacity of a filter for removing B.O.D. apparently varies with the strength and characteristics of the applied sewage. With normal strength domestic sewage, 2.0 lbs. of B.O.D. per cu. yd. of filter medium per day appears to be the maximum that can be removed.

7. Recirculation of filter effluent back to the detention tank is of material aid in controlling the degree of purification obtained. In general the recirculation ratio should be increased in proportion to the increase in strength of the raw sewage. In the case of normal strength sewage this ratio should be about 2.0 for single-stage intermediate treatment, 1.5 for single-stage complete treatment and 1.0 for two-stage treatment.

8. The detension tank design becomes increasingly more important as the B.O.D. load on the filters is increased. The average clarifier overflow rate should not exceed 800-1000 gals./sq. ft./24 hrs. in the case of single-stage plants, and 1200-1500 gals./sq. ft./24 hrs. in the case of two-stage plants. Average clarifier detentions should not be less than 1.5-2.0 hours.

9. Within a range of about 8.0 to 100 m.g.a.d., dosing rates apparently do not affect the action in the filter bed as long as the limiting B.O.D. load is not exceeded.

10. Increasing the filter bed depth beyond 3 ft. gives only a slight improvement in results and, therefore, is not warranted.

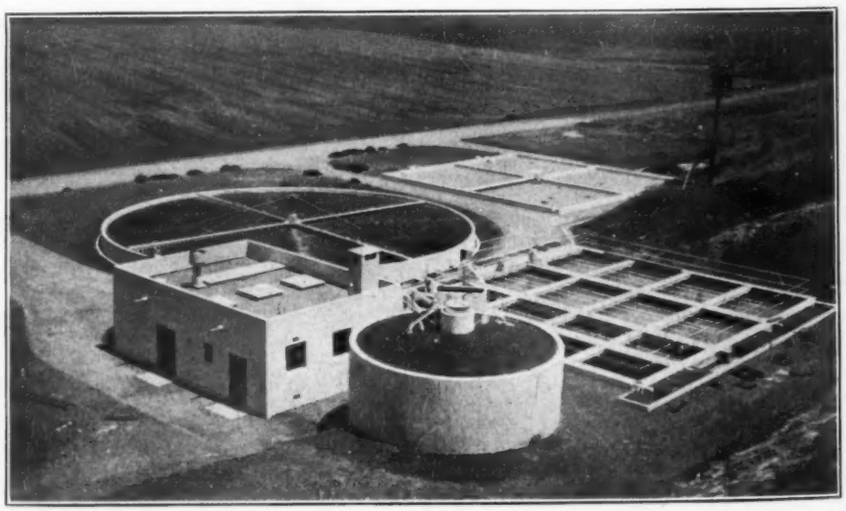
11. The Biofilter System may be applied for the pre-treatment of very strong industrial wastes. In the case of distillery wastes having a B.O.D. of about 20,000 p.p.m., over 90% reduction in B.O.D. may be effected in a single-stage 3-ft. depth filter.

12. In the treatment of strong wastes such as distillery waste, very high B.O.D. loadings may be applied to the filters without seriously affecting their capacity for B.O.D. reduction. In the case of distillery waste, B.O.D. loadings of 18-20 lbs./cu. yd. were applied. The removals through the filters were 15-18 lbs./cu. yd./day.

TABLE 9

Biofilter Test Results—Distillery Waste

Test No.	I	II	III	IV
Raw Dosing Rate—M.G.A.D.	0.784	0.784	0.653	0.784
Total Dosing Rate—M.G.A.D.	26.1	26.1	32.7	0.784
Recirculation Ratio	32	32	49	0
B.O.D.—5-day				
Raw	18,700	19,500	18,500	15,800
Primary Filter Effluent	1,610	8,710	2,630	21,500
Secondary Filter Effluent	1,100	5,900	1,900	5,000
Primary Removal—Per cent	91.4	55.3	85.8	....
Total Removal—Per cent	93.2	69.8	89.7	68.4
pH Value				
Raw	3.2	2.5	2.4	2.8
Primary Filter Effluent	7.3	5.2	7.5	3.9
Secondary Filter Effluent	7.3	6.8	7.5	6.0
Per cent Total Solids				
Raw	1.80	1.80	2.10	1.64
Primary Filter Effluent	0.26	0.28	0.22	1.24
Secondary Filter Effluent	0.24	0.20	0.24	0.28
No./c.y./day	8.79	9.16	7.07	7.43
Aver. Raw B.O.D. Loading—				



Single Stage Complete Treatment Biofilter Plant—Camarillo State Hospital, California

A NEW SEWER MAINTENANCE TRUCK

Specially Designed on Basis of Experiences With Earlier Trucks

By E. P. DECHER
Purchasing Agent and Ass't Sec'y
JOINT MEETING MAINTENANCE
NEWARK, N. J.

THE Joint Meeting, a Sewer Commission comprised of the following municipalities: City of East Orange, Township of Hillside, Town of Irvington, Township of Maplewood, Township of Millburn, City of Newark, Boro of Roselle Park, Village of South Orange, City of Summit, Township of Union, Town of West Orange, in Essex and Union Counties, New Jersey, having approximately fifty-six miles of main sewers, found that it was necessary to purchase a new motor truck and body to replace an old one that had been equipped for service as a maintenance and repair truck.

When this matter was brought up for discussion the Commissioners emphatically emphasized the fact that they desired to have a truck body made to answer all needs and it must be so constructed as to be able to carry the necessary tools and equipment so that the inside of the body would be free for the loading of any material when required, and at the same time should any of the equipment or tools be needed they would be available and ready for use without any inconvenience.

The Author

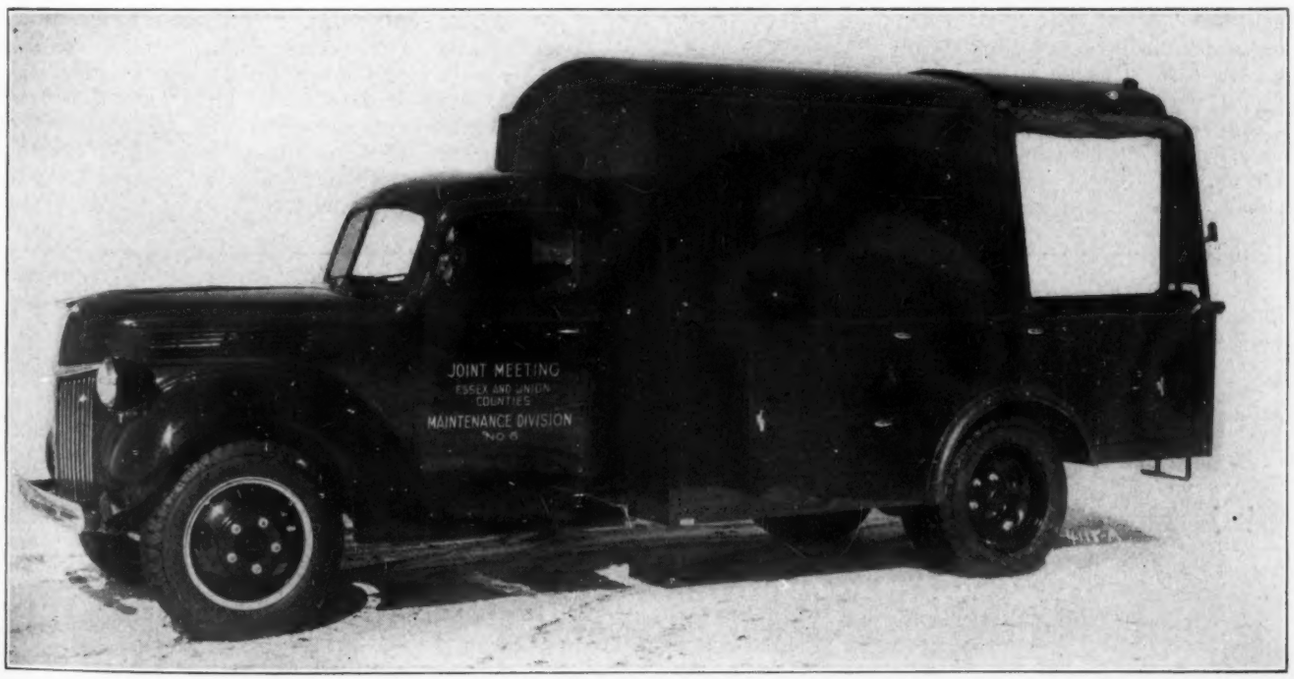
We Undertake a Special Design

To undertake the design of a body to meet the requirements as recommended by the Commissioners was no small undertaking, as it was necessary to give consideration to each and every item.

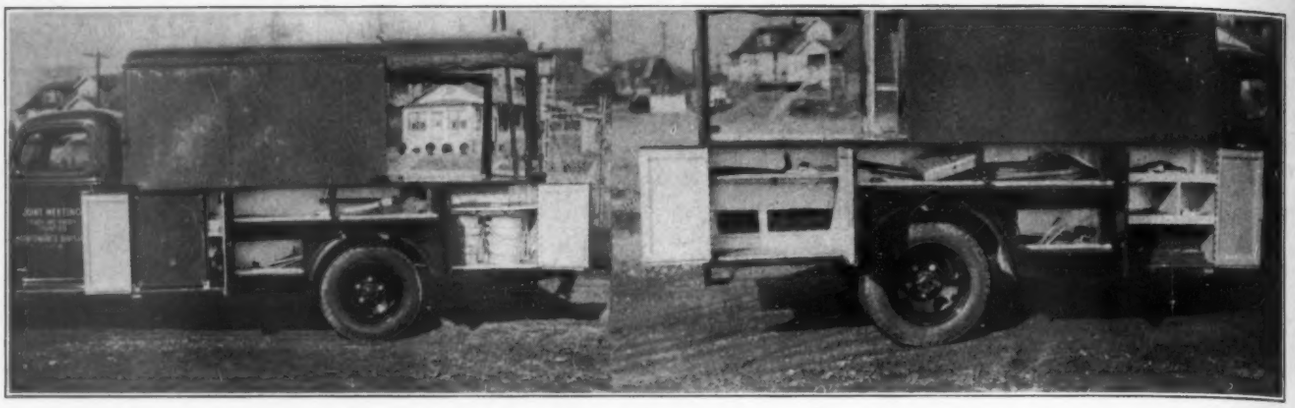
The Commissioners were very emphatic that the safety and first aid equipment was, in their minds, the most important and was to be given first consideration.

The Commissioners then decided that a chassis of 1½ to 2 ton capacity would be sufficient to answer our needs. After this decision was made we knew that the dimensions from the rear of the cab to the center line of the rear axle known as the CA Dimension, would not be less than 84 inches. This was important information and necessary in order to prepare a preliminary design for the length of the body that would be placed upon the chassis. We then knew that the total length of the body could not be longer than 12 feet on a standard size frame without an over-hang.

From that information the next step was to measure each and every piece of equipment (width, length, and height), that would be carried in side compartments. When this information was completed a check-



Specially Designed Sewer Maintenance Truck of the Joint Meeting.



Left and Right Sides of Truck Showing Compartments Opened.

up plan was prepared of the body to see whether or not all of the equipment could be accommodated. Several preliminary sketches had to be made before this was accomplished, one of the reasons being to keep the body in proportion and that the body would not be much wider than the clearance of the front end of the chassis.

The case containing the Davis Hose Mask and Combination Velocity Blower, and the case containing the Davis Oxygen Inhalator were the two largest items, and required the greater amount of compartment space.

Left Side of Truck

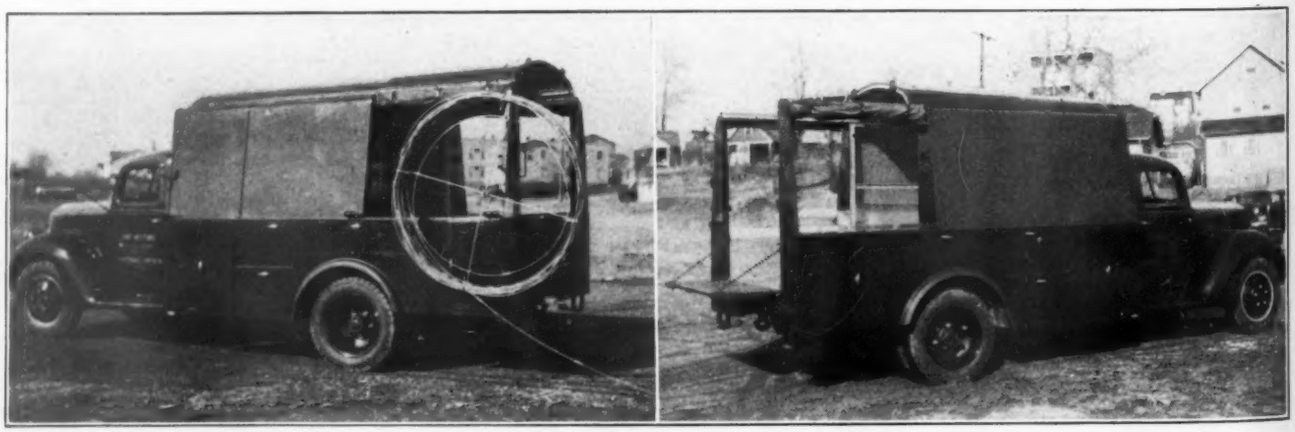
You will notice in the pictures that a space was provided on the left side in the front of the body, for the case containing the blower and the hose mask, etc. This compartment was also designed to accommodate the Hydrogen Sulfide Detector, Oxygen Deficiency Lamp, Mine Safety Carbon Monoxide Detector, Combustible Gas Indicator, Chipping Goggles and one Industrial First Aid Kit.

The center compartment on this left side was designed to accommodate long handle equipment, such as shovels, crow bars, sledge hammers, wooden mauls. The compartment beneath this was made to carry bull points and other necessary tools for our compressor. The rear compartment was divided into two sections, the lower half for eight sixteen-quart pails and the upper half for collapsible safety signs and signals that are used in barricading open man-holes.

When the pails are removed there is an inner concealed compartment provided for masonry tools. This compartment is provided with a sliding shutter and can be closed when the tools are not required, after which the pails can be stored without any difficulty.

Right Side of Truck

The compartments provided on the right-hand side of the truck are also pictured. It will be noticed that the upper portion of the rear compartment is used for specially made man-hole hooks, rubber gloves, and the voice-powered telephones. (These phones are for communicating with men down in sewers.) There is also placed in this compartment (not shown) a box specially constructed to provide various sized compartments for different sized nails and screws. The lower portion of this compartment has the same amount of recess as the rear compartment on the left side. The lower portion being used for sewer rods and the upper part for carrying the Davis Inhalator. Our experience has taught us that the placing of sewer rods cross-wise in the body of the truck is more convenient than the old arrangement of having them installed in a compartment, running length-wise. The center long compartment with two doors is also used for carrying brooms, shovels axes, and other necessary tools. The lower compartment is used for carrying various sized hose nozzles, hydrant adaptors, siamese connections, self-propelling ferret, revolving nozzles, joint runners, wrenches and handles for our Turbine Sewer Cleaning equipment, and various other items too numerous to mention. The front compartment is divided into four divisions. The lower division for our electric drill, hydrant wrenches and other small tools that are carried in a tool kit. The other three compartments are for small sewer cleaning tools used in connection with our "Flexible" sewer cleaning equipment.



Two Views to Reveal Flexible Sewer Rod in Position for Use and Sliding Rear Top Section.

Interior of Truck

A rear view of the inside of the truck is presented. Two compartments are provided on the right-hand side with double doors. These compartments were designed to accommodate rubber boots, coats and hats. Compartments are provided on the left side (interior) to accommodate various sizes of ropes, safety belts, electric extension cords. Under these compartments, the full length of the body, provision is made for the wooden skids. Openings are made in the rear of the truck floor at the tail gate to accommodate the wooden skids for different widths. These enable us to load our pumping equipment or compressor without any difficulty. There is also provided in the rear of the truck a pentel hook for towing any equipment that may be necessary to move from one job to another.

In order to facilitate loading of our equipment there is provided on the floor in the front end of the body a bull ring which is used for attaching a block and tackle for loading purposes. It will be observed that section one and two of the roof are permanent and the third section (rear) is telescopic and can be slid back. We have found this facility to be of great advantage, because it enables our men to stand upright without fear of bumping their heads and also enables us to transport equipment which could not be handled if the top was fixed. The height of the truck body, from the floor to the highest point in the center is 6 feet, the width of the body being 7 feet.

It will be observed that the sides of the last section on both sides of the body were not enclosed the same as the first and second section for the following reasons. The inside of the body is so arranged that it can be divided into three compartments. Angle irons were installed and were so arranged that we are able to slide in a set of batch boards for carting sand, stone and earth, or any other material, without coming in contact with each other. The side openings on the body enables the loading and unloading of these three separate compartments without any difficulty. These two side openings and the rear are provided with extra heavy canvas curtains which can be lowered so that the entire truck can be enclosed should that be necessary at any time.

Flexible Rod Mounting

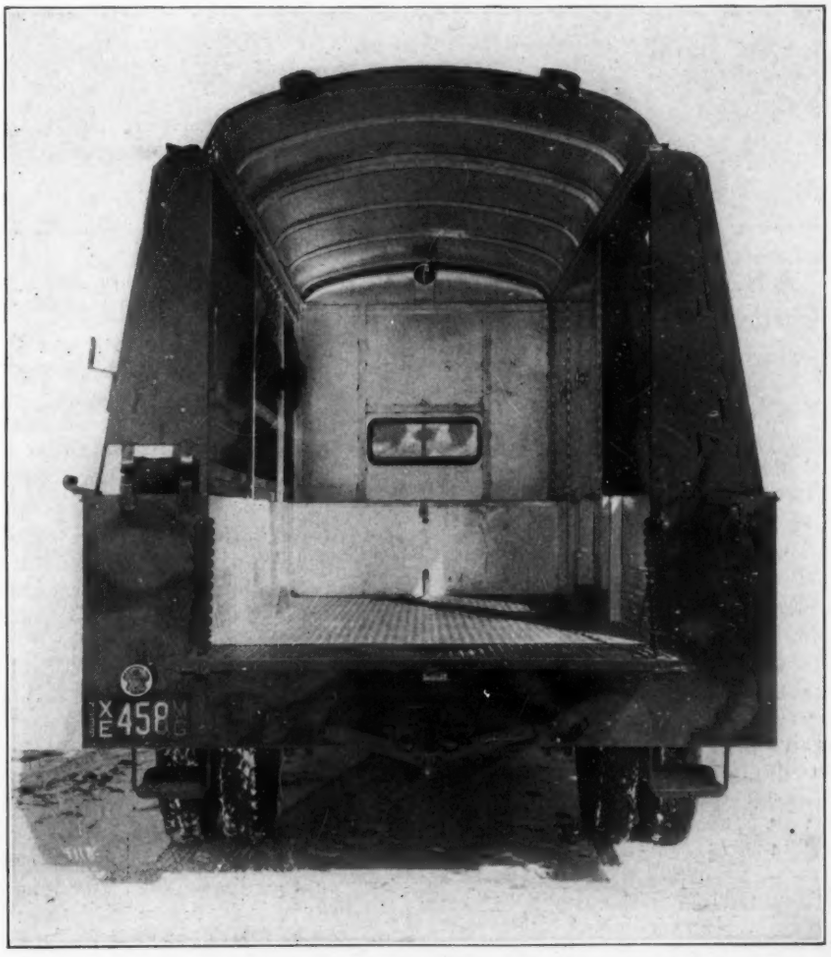
A photograph shows our "Flexible" sewer rods mounted on a stationary arm which gives more flexibility when using this equipment than the old method provided. The flexible rod is only placed on the outside of the truck when in use, when not in use it is carried on the inside of the truck in an upright position strapped against the support arms provided for this purpose. The truck is also equipped with ladder brackets to carry ladders if necessary, as we oftentimes are required to use ladders.

All-Steel Construction

The body of this truck is of 100 per cent steel construction. All of these compartments are so constructed that they are absolutely water proof, thereby affording a considerable saving in the deterioration of tools and equipment. The side compartments are made of 18 gauge steel and are assembled by electric and shot weld methods. Compartment doors are all welded pressed steel framing of 20 gauge and provided with slam locks and full length piano type hinges. There is a seat box across the front of the body which is used as a seat for the convenience of our men and to carry our portable electric generator flood lights and flushing hose.

This body was constructed by Peter Wendell and Son, of Irvington, N. J. In the design and construction credit is due our Chief Engineer, Mr. Leslie E. West, and Mr. Corey W. Sandford, Supt. of Sewers. Periodic inspections during the construction of the body were also made by Hon. Peter A. Smith, Chairman of the Commission. The chassis is 1½ to 2 ton Ford with a 95 horsepower engine.

It came equipped with an extra booster for extra breaking power and one 19-plate 180 Ampere Hour Edison storage battery and an extra heavy duty generator. The reason for the last two being that it is anticipated that this truck will also be equipped with short wave radio in the same manner as our other truck. This truck has now been in use for a period of five months, and we have found that it completely answers our needs and that nothing has been over-looked.



Interior Arrangements.
(For Details See Text)

(Photo Courtesy Chicago Bridge & Iron Works)

A Million Gallons of Beauty

For its sheer beauty, this picture really rates a position on our front cover instead of in this location. We are reproducing it as another example of what may be accomplished with simple architectural treatment of the "ugly duckling" of yester-year—the lowly standpipe.

This unit has recently been installed by the Stamford Water Company at Stamford, Conn. It is 50 feet in diameter and 75 feet high, holds 1,000,000 gallons. It is to be noted also that the standpipe of today need no longer be the open-top unsanitary unit that it was in days gone by. The shallow dome adds beauty as well as providing protection against bird pollution and dust—and who knows, in these days, but pollution from aeroplanes also.

This picture likewise gives evidence of the part which modern welding has played in making such structures less costly to construct and maintain, and at the same time more effectively attractive in appearance.

A SOLUTION FOR Ceiling Sweat Problems

Ceiling sweat often is a nuisance, and the question is "How can we prevent it?"

Briefly, without going into technical details or explanations, there are two ways in which to prevent ceiling sweat:

1—Apply an ample thickness of suitable insulation to the roof;

2—Keep the air "dry" inside of the building or room.

Regarding Method No. 2, which is the more difficult of the two in the long run, it is not necessary to keep the air "perfectly dry." In fact, it is exceedingly difficult to produce air that is perfectly dry even in a laboratory. To prevent sweat in any room it is only necessary to hold the humidity of the air down low enough so that no "dew point" will be established on the ceiling. By keeping the air properly dry it will absorb any tiny particles of sweat that may manage to collect on the ceiling, and dripping will thereby be eliminated.

Here is a new rule that was developed for simplifying the computation of ceiling sweat problems. It gives the limiting relative humidity under a wide range of conditions:

Rule: Subtract the outdoor temperature from the indoor temperature (both in degrees F.), multiply the difference by 0.19 and then subtract the product from 100. The remainder is the relative humidity limit. Should a greater relative humidity be permitted in the room, ceiling sweat is likely to occur.

But (and this is important), the above rule applies only to a well insulated roof—4 inches of concrete, plus 2 inches of corkboard, plus 5-ply roofing. It will be found on checking the above rule that if the temperature is 10 deg. F. *below* zero outdoors, and 70 deg. F. indoors, the relative humidity indoors can be over 80 per cent and there will be no ceiling sweat. But if the humidity goes above 84.8 per cent there will be ceiling sweat.

For a roof made of 4-inch gypsum composition in place of the above structure, use 0.3 in the rule instead of 0.19. For a roof made of 2½" tongue and groove spruce planking, plus 5-ply roofing, use 0.5 instead of 0.19. For a roof made of 1½" tongue and groove spruce planking, plus 5-ply roofing, use 0.62. And for a roof that is made of bare concrete 4 inches thick, use 0.94 instead of 0.19.

A Solution—

Naturally, then, the most practical method of solvnig the problem is that of maintaining sufficient warmth on the underside of the ceiling to prevent temperature drop sufficient to create the "dew point" which becomes manifest in the condensation of water vapor on the cold surfaces. Where pipes containing cold water are involved, sweating is frequently prevented by covering such pipes with insulating materials—one such being ground cork applied admixed in paint, or a bituminous coating compound.

*By W. F. Schaphorst, M.E., Newark, N. J.

W. P. HUGHES

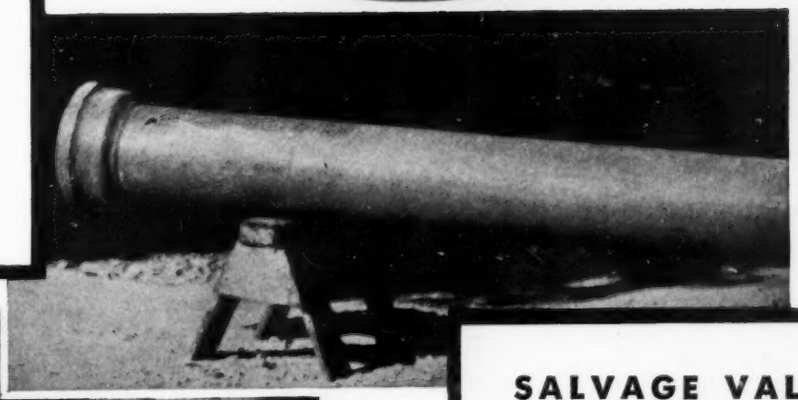
Former Chairman, Pacific Northwest Section, A.W.W.A., and City Engineer of LEWISTON, IDAHO

writes: "During the past 16 years (nection with an extensive paving pr the City of Lewiston has replaced per cent of their water mains with lineal feet of cast iron pipe from inch diameter. The system is operat a maximum pressure of 90 pou maintenance cost on the 29 miles iron pipe laid has amounted to le 75 cents per mile per year."

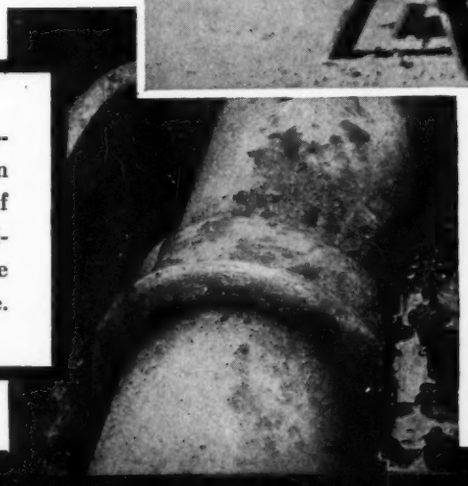
W. P. Hughes

LOW MAINTENANCE

is an economy factor in cast iron pipe that is usual, rather than exceptional, in water works experience. An impartial survey among nearly 200 water works superintendents shows that the maintenance cost of cast iron pipe is far below that of any other pipe material which has been in use long enough for the recording of conclusive data.



LONG LIFE Unretouched photograph of a section of original cast iron water main now in its 101st year of continuous service in Detroit, Michigan. Long life is but one of the economy factors of cast iron pipe.



SALVAGE VALUE

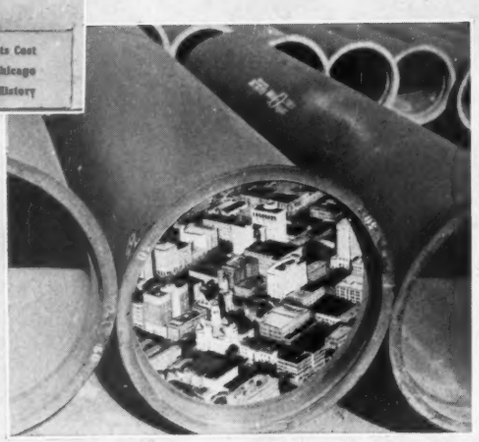
Unretouched photograph of 8-inch cast iron pipe laid in 1884 and recently salvaged and relocated in Hopkinton, Mass. Salvage value is one of the 3 economy factors of cast iron pipe.

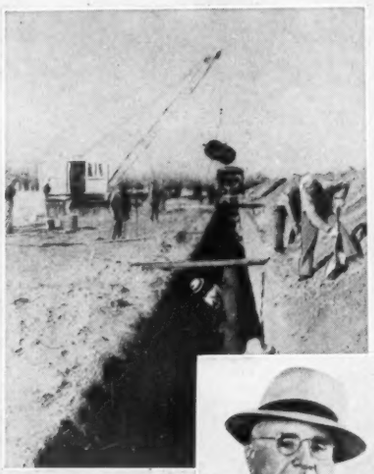
CAST IRON Look for the "Q-Check" registered trad mark. Cast iron pipe is made in sizes from 1¼ to 84 inche

ENGINEERING
NEWS-RECORD
Laying 48-in.-diameter cast-iron pipe for 30-mile water-line across Kansas prairies.
AUGUST 15
1940
New Staggered Floor Garage Design Cuts Cost
Bridging Busy Electrified Tracks at Chicago
Wichita Makes Cast-Iron Water Pipe History

WATER FOR WICHITA

33 MILES OF BELL AND SPIGOT MAIN





● Congratulations are due those whose vision and skill planned the work—Black & Veatch, Kansas City, the Consulting Engineers; also to W. B. Carter, Wichita, the able Contractor, whose picture appears above.

A Tegul PRODUCT
TEXAS GULF SULPHUR COMPANY

A NEW RECORD IN PIPE LAYING!

22 miles of 48" diameter - the rest 42" to 14" diameter

... AND THE JOB COMPLETED AND IN SERVICE IN THIRTY-EIGHT WEEKS

You've heard about this big Kansas job, but do you know how it was possible to expedite the laying, to back fill as the job progressed, and to have the line in service in nine working months from the start?

The Wichita Water Supply Improvement job has been in the news for months. At the left you see it pictured on the cover of ENGINEERING NEWS RECORD of August 15th.

This great piece of engineering brings water to Wichita from a group of gravel wall wells located in the general area west and south of Hallstead, Kansas, 33 miles away.

KNOW ANY RECORD TO MATCH THIS?

The Engineers' specifications allowed for maximum leakage of *100 gallons* per inch, per mile. Trenches were back filled as the job progressed. No tests were made until the 33 mile line was completed. The actual leakage within two weeks after water was turned into the line was *39 gallons* per inch, per mile.

Good Pipe! You bet!! But no pipe is better than its joints. They had to use good *jointing compound* too — and they *did!* — *Tegul*-MINERALEAD—325,000 lbs. of it.

TIME MARCHES ON and the job keeps pace

The first *Tegul*-MINERALEAD joint was poured on October 7th, 1939. Winter weather made it necessary to shut down on the job for two months. Yet water was turned into the filter plant on September 1st, 1940. The actual laying time — nine months — gives some idea how *Tegul*-MINERALEAD helps pipe laying to move right along with no loss of time.

HOW ABOUT *YOUR* PIPE LAYING AND JOINTING?

Your job may be smaller in terms of miles and perhaps of diameters—but it's no less important to you that the joints be tight—able to withstand any vibration, also to meet extraordinary thermal and mechanical shock—and that no time be wasted in speeding your job through to completion.

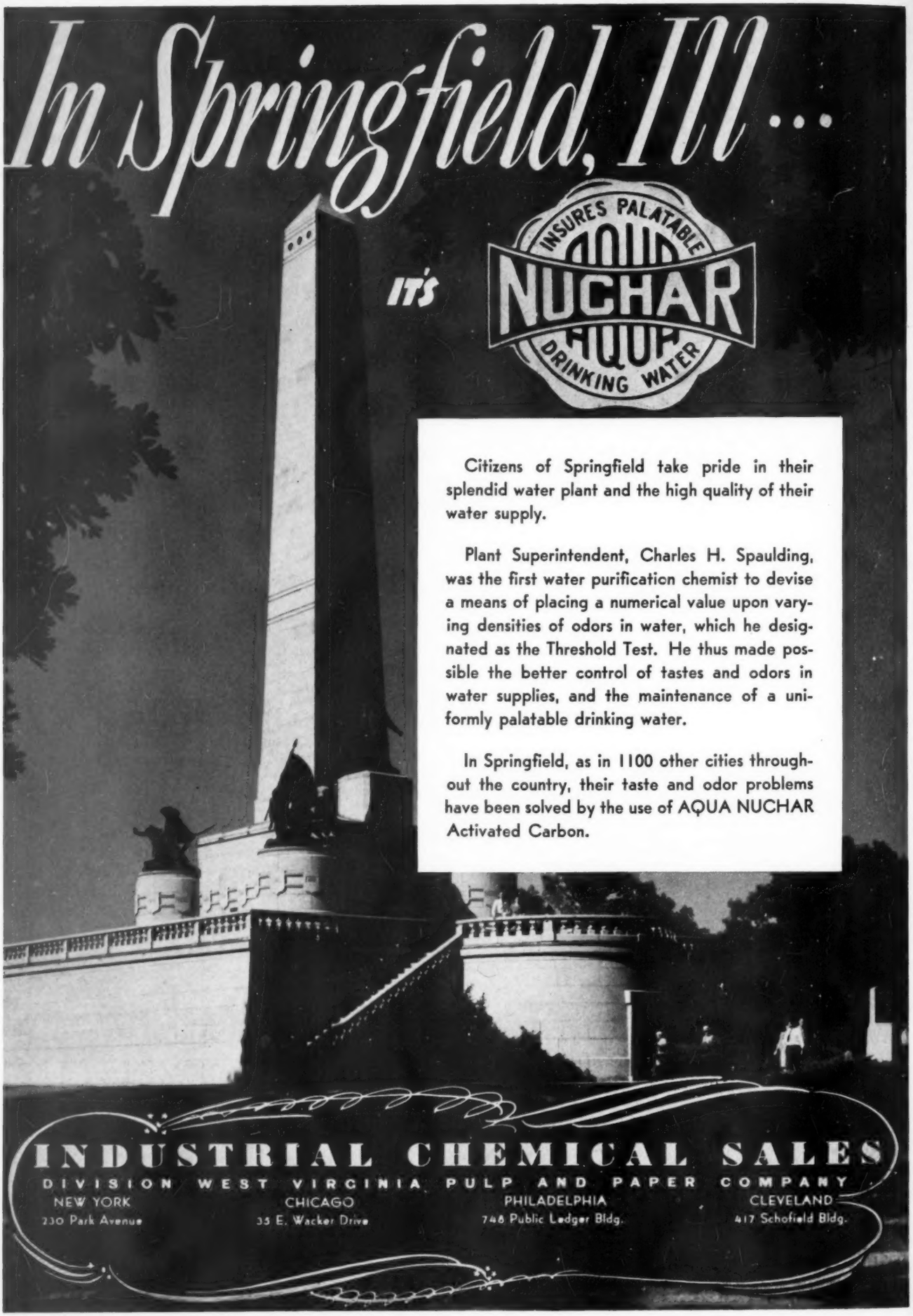
RULING WEATHER TROUBLES OUT

In winter and summer alike, you'll o.k. a compound that can be stored in the open with never a worry about rain, snow and flood. You'll be glad to find it can be handled easily. Those 10 lb. *Ingots* of *Tegul*-MINERALEAD make units that are convenient to ship, store and handle on the job, saving space and time, and easy on labor. Further, *Tegul*-MINERALEAD needs no caulking, no deep bell holes, no skilled labor.

If you have used *Tegul*-MINERALEAD, you're probably enthusiastic about its advantages . . . and its pleasingly low cost. If you *haven't*—then do yourself a good turn right now. Send us a line asking for Time- and Money-saving Information on the subject of Better Bell and Spigot Main Jointing.

The ATLAS MINERAL Products Company of Penna., Mertztown, Penna.

Tegul-
MINERALEAD


In Springfield, Ill...
IT'S
INSURES PALATABLE
AQUA
NUCHAR
AQUA
DRINKING WATER
Citizens of Springfield take pride in their splendid water plant and the high quality of their water supply.
Plant Superintendent, Charles H. Spaulding, was the first water purification chemist to devise a means of placing a numerical value upon varying densities of odors in water, which he designated as the Threshold Test. He thus made possible the better control of tastes and odors in water supplies, and the maintenance of a uniformly palatable drinking water.
In Springfield, as in 1100 other cities throughout the country, their taste and odor problems have been solved by the use of AQUA NUCHAR Activated Carbon.
INDUSTRIAL CHEMICAL SALES
DIVISION WEST VIRGINIA PULP AND PAPER COMPANY
NEW YORK
230 Park Avenue
CHICAGO
35 E. Wacker Drive
PHILADELPHIA
748 Public Ledger Bldg.
CLEVELAND
417 Schofield Bldg.

Ewing Galloway

SEWAGE FILTRATION

(Concluding Installment)*

Part 3—Potentialities of Effluent Filters in the Economy of Sewage and Waste Treatment—Design and Operation

By PHILIP B. STREANDER
Consulting Engineer
NEW YORK, N. Y.

The Author

Economics of Sewage Filtration

PRIOR to the advent of the effluent filter in sewage treatment the only equipment employed in removing settleable solids from sewage was the settling tank or slow rate sand filters. Settling alone has never constituted a genuinely positive means of removing material as variable in its characteristics as the so-called suspended solids of sewages and wastes. Much research work has demonstrated that the efficiency of solids removal by a settling tank is influenced by the shape of the tank, the velocity of flow, the temperature of the sewage, the strength of the sewage in parts per million, the age of the sewage and the most important of all factors, the settleability of the solids. It is not the purpose of this discussion to discuss these factors, but primarily to point out that anticipated settling tank efficiencies are often not secured due to neglect in considering all of these factors when designing settling tanks. For these reasons it is believed that more study should be given to the inclusion in treatment plants of more positive means of removing the solids, means that are not affected nor influenced by the several factors mentioned.

Under most conditions the major settling takes place during the first hour and an ideal condition exists when the velocity of flow is sufficiently reduced to permit solids of greater gravity than the liquid medium to fall below the line of liquid movement within the tank. The economics of settling tank design can be approximately stated by reference to the experiments conducted by Holmes at Syracuse, N. Y., as shown in Fig. 18, which reveals setling rates of solids in sewages of different strength and under varying detention periods. For example, if the crude sewage contains 250 p.p.m. suspended solids, the following removals are indicated:

Detention Period Hours	Percent Solids Removed	Percent Removed Per Hour	Solids Removed (p.p.m.)	Solids in Effluent (p.p.m.)
1	61	61	152	98
2	66	5	13	85
3	70	4	10	75

With a weak crude sewage, containing, say, 150 p.p.m. suspended solids, the removals according to this chart would be as follows:

1	55	55	82	78
2	61	6	10	58
3	65	4	6	52

These results may be modified by many factors, but the fact remains that practically all of the settleable solids are removed during the first hour. Therefore this probably represents the maximum in settling tank economy, as with a settling tank three times as large only about 10 per cent more solids are removed. In either instance the efficiency of the sedimentation process is determined by the ratio of suspended solids that will settle and those which without something to assist gravity will not settle in any reasonable time.

This comparison is made on the basis of the data given, but other studies of sedimentation indicates that the major portion of gravity influenced suspended solids are removed during the first hour. Longer detention periods are only necessary to compensate for poor flow distribution, or design, and unusual peak rates of flow. There is therefore no economic need for long detention periods provided other positive means are available to remove the 10 per cent of solids representing the difference between one and three hour settling periods; and, at the same time, additional solids.

The information available from rapid sand filter operation, experiments and actual study, indicates that in its present form effluent filtration offers a means of reducing settling tank volumes to their economic size and further provides means for the removal of a large part of the finer and non-settleable solids that cannot be removed by settling tanks regardless of any practical detention periods provided.

Rates of Filtration

Rates of filtration have in most instances been confined to those below one gal. per sq. ft. per minute, as the efforts of the manufacturers have been confined to securing the maximum removals possible. While such efforts were undoubtedly worth while, and actually necessary to demonstrate the effectiveness of this intermediate method of treatment, the result is that an impression has been created that effluent filters can only operate at low rates of filtration. This is an incorrect assumption as they can operate at much higher rates provided the beds are properly cleaned. The rate depends on the removals to be effected, but is controlled to some extent by the hydraulics and the design of the filter. A low rate of filtration, with similar loading and loss of head, will naturally result in longer filter runs

*The first and the second articles in this series appeared in "Water Works and Sewerage" for August and September, 1940.

and less wash water, while high rates, under similar conditions, will result in shorter runs and consequently more wash water. This holds true for shallow or deep sand filters, but in a degree varying with the depth of the bed. Due to lack of confirming data no definite statements can be made covering the relative economies of high rate and low rate filters and it is to be hoped that future experiments, or actual plant operation, may disclose results on which such a comparison can be made.

Disregarding the rate of filtration, and basing conclusions on filter results now available, it is indicated that effluent filters are capable of removing a large portion of the suspended solids present in settling tank effluents. The per cent actually removed depends somewhat on the loading of the filter bed and on the state of division of the solids in the filter influent, but the rather consistent results secured so far indicate that the removal averages 50 per cent or better, irrespective of filter loading, when the bed is automatically cleaned by means of float operated switches controlled by a predetermined loss of head through the bed.

Referring again to the chart (Fig. 18) showing solids removed by settling tanks, it is indicated that effluent filters, capable of removing from 15 to 20 per cent of the solids remaining in a sewage settled for a one hour period, would produce better overall and superior results to those secured by a three hour settling period. This is particularly true when considered on the basis of total putrescible content. As the filters can actually remove about 50 per cent of the solids the comparison would be as follows:

	Settling Tank Raw Sewage 250 p.p.m.		Effluent Filters Filter Influent 98 p.p.m.	
	Solids Removed	Solids in Effluent	Solids Removed	Solids in Effluent
1 hour detention.....	152	98	49	49
3 hour detention.....	175	75	..	..

According to the foregoing, the additional two hour settling period only removes about 23 p.p.m. of suspended solids, whereas effluent filters remove about 49 p.p.m., or more than twice the solids removed by the added two hour detention period. This is equivalent to an overall removal of about 80 per cent. Certainly this efficiency cannot be secured by settling tanks alone, unless chemicals are added to coagulate the finely divided solids, and even then the results are non-uniform and the expense great.

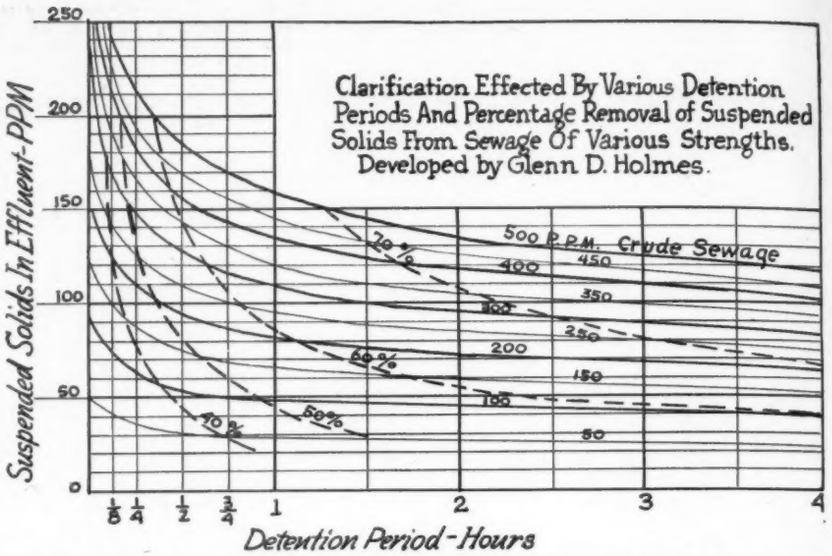


Fig. 18.—Setteability and Settling Rates of Suspended Solids Carried in Sewages of Various Strengths as Indicated by Solids Content.

(From data assembled by Glen D. Holmes in studies conducted at Syracuse, N. Y.)

This would then indicate that the inclusion in the plant of properly designed effluent filters will produce a degree of treatment far beyond the capabilities of settling tanks, irrespective of detention periods, and closely approaching results produced by efficient chemical treatment. In connection with this it may be stated that the fixed and operating cost for a plant consisting of a short detention settling tank and efficient effluent filters, would not be as high as similar costs for a chemical treatment plant effecting the same degree of treatment. The capital costs of such plants would probably be about the same. Labor and power costs would be approximately the same for the two plants, but as no chemicals would be required in the settling and filtration plant, its total operating cost would be less. From observations and studies made it is indicated that the cost, per unit of solids removed, is less for short detention settling tanks and straining filters than for any other method of removing equivalent amounts of suspended solids from the sewage.

It is believed that economies in plant cost can be effected by reducing the capacity of the settling tanks to that required to remove the easily settled suspended solids and using filters to remove the lighter and more difficult to settle solids. At the present time many State Departments of Health designate their treatment requirements to consist of primary treatment or secondary treatment and in some instances extending this to include chemical treatment as an intermediate step. However, there are many instances where a high degree of solids removel is required so as to prevent the formation of sludge banks, but where the oxidizing power of the river is ample to take care of the oxygen demand and under such conditions not requiring oxidation or secondary treatment. For such conditions settling tanks and effluent filters will effect a high removal of the suspended solids.

Applications of Effluent Filters

Activated Sludge:

In addition to the application of mechanically cleaned filters to raw sewage settling tank effluents, they can be applied as economically to activated sludge plants. In activated sludge treatment the heavier sludge particles are those that are generally the most desirable for return to the aeration tanks. The lighter particles are of no particular benefit to the system (in fact a detriment) and therefore are not necessary for its operation. At most activated sludge plants the detention period in the final settling tank is about two hours, this long detention period being required to settle out the finer and the pin-point floc. The best activated sludge settles rapidly; therefore, the heavier and active portion of the sludge can be settled out in a reduced tank volume and the lighter non-active por-

tion and the pin-point floc can be removed by effluent filters. Less effective aeration can be employed where effluent filters are used, as the aeration need not be carried to the same degree and, therefore, economies can be effected in power costs. Effluent filters in activated sludge treatment plants will also improve the appearance of the effluent. Further, their use is indicated for a sewage of very high strength, or one containing industrial wastes that interfere with the operation of an activated sludge plant.

Trickling Filters

Mechanically cleaned effluent filters can be and are applied to trickling filter plants. For such service they remove the major portion of the solids contained in trickling filter effluents, particularly during the so-called filter bed unloading periods. While the oxygen demand of these solids is not proportional to their amounts, having been digested within the lower portion of the bed under anaerobic conditions, they are unsightly and detract from the otherwise excellent results secured by the trickling filter method of sewage treatment.

From information now available it is clearly indicated that properly designed effluent filters will also undoubtedly be required for the so-called bio-filtration system (high rate filters) of sewage treatment. In this method of treatment the characteristics of the resulting sludge reaching the final settling tank are more nearly those of activated sludge than of trickling filter sludge. This means that the sludge solids are light and of a low specific gravity, flocculant in character and somewhat difficult to remove by sedimentation. These solids, unlike trickling filter effluent solids, are not stable and are decomposable. Their presence in the effluent will therefore reduce the efficiency of the process to an extent somewhat comparable to the amounts of solids present. Their removal by efficient effluent filters will therefore increase the efficiency of this method of treatment. The use of effluent filters in this method of treatment can also be compared to their use following final settling tanks in activated sludge plants, whereby the size of the final settling tank can be reduced by removing the finer and more difficult to settle solids by means of effluent filters, rather than through more costly design or treatment.

Some work has been done to demonstrate the efficiency of effluent filters for chemical treatment plants. This has shown that chemical costs can be reduced by using effluent filters, as far less chemical doses can be used than where it is required to secure a clean cut break in floc formation. Effluent filters are used in a number of chemical treatment plants using either split floculation or complete floculation. It can be safely stated that efficient effluent filters greatly improved the appearance of the effluent and also the degree of treatment effected.

In conclusion, it is believed that efficiently cleaned effluent filters have a wide range in sewage treatment plants and will be increasingly used when engineers become more conversant with the operating results and the work they are capable of performing. In brief, they can be used and applied to the following parts and types of sewage treatment plants:

1. Plain sedimentation — Primary treatment.
   (a) Where higher removals are required.
   (b) Combined with short detention settling tanks.
   (c) Where existing settling tanks are overloaded.
2. Chemical Coagulation—Intermediate treatment.
   (a) To secure maximum treatment results.
   (b) To reduce chemical costs.
   (c) To improve effluent appearance.
3. Activated Sludge — Secondary treatment.
   (a) Following final settling tanks to effect more complete removals of solids.
   (b) To reduce the size of the secondary settling tank.
4. Trickling Filters—Secondary treatment.
   (a) Following secondary settling tanks to effect more complete removal of solids.
4. Bio-Filtration System—Secondary treatment.
   (a) Following final settling tanks to not only effect a more complete removal of solids, but also to increase the treatment efficiency and enhance appearance of the effluent.
   (b) To reduce the size of the final settling tank.

In addition to its applicaiton in the field of sewage treatment, efficient effluent filters can also be extensively applied to the treatment of industrial wastes. In this application the filter can, in many instances, be used as the sole method of treatment, being preceded with a fine screen to remove the solids that might interfere with the proper cleaning of the bed. In other instances it may be necessary to use short detention settling tanks, chemical coagulation, biological treatment, but where solids, either organic or inorganic in character, must be removed, it is indicated that effluent filters will accomplish this more economically than other present known methods.

It is the writer's belief that this matter of dollars and cents value of effluent strainers has only begun to be realized, and that the future will find these worthy adjuncts to treatment plants coming into widespread use as an economy feature as well as being producers of a more even and dependable quality of plant effluent.

DR. ELIASSEN JOINS N.Y.U. ENGINEERING FACULTY

Prof. Rolf Eliassen

The appointment of Rolf Eliassen as associate professor of sanitary engineering in the New York University College of Engineering has been announced by Dean Thorndike Saville.

In addition to his teaching duties in the department of civil engineering, Professor Eliassen will be in charge of the work in the Sanitary Engineering Research Laboratory, succeeding the late Professor Lewis V. Carpenter. This laboratory was built in 1937 by New York City at University Heights and is jointly operated by the City and the University.

Before coming to New York University Professor Eliassen was assistant professor of sanitary engineering at the Armour Institute of Technology, Chicago. He attended the Massachusetts Institute of Technology where he received the degree of Doctor of Science in Sanitary Engineering in 1935. That same year he served with the consulting sanitary engineering firm of J. N. Chester Engineers of Pittsburgh. From 1936 to 1939 he was associated with the Dorr Company, engineers and manufacturers. During this time he was engaged in research and development, and in the operation, design and construction plants for the treatment of water, sewage, and industrial wastes in the Mid-West and on the Pacific coast. For the past year he has been teaching at Armour Institute.

FORECASTING BY MEANS OF CLIMATIC CYCLES

By HALBERT P. GILLETTE

THE ultimate goal of meteorology is accurate long-range forecasting. To be of greatest economic value, such forecasting must relate to rainfall decades ahead, for in many cases water supply systems are designed to meet the needs not only of the present but of the next generation. To many people it may seem visionary even to discuss ways of attaining such a goal, because, after more than a century of research, forecasts by government weather bureaus throughout the world are usually limited to a few days in advance. But to reason that a scientific goal is not to be attained in the near future because it has defied attainment in the past is neither logical nor does it show acquaintance with the history of scientific progress. Again and again difficulties that seemed insurmountable have suddenly been overcome by some new attack. Often the successful attack has had less of novelty than of energy in its prosecution and faith in a successful outcome. Pessimism was never the parent of any discovery.

No one has ever suggested any method of very long-range forecasting except by aid of cycles. There are so-called correlation methods of forecasting a few months in advance; and such partial successes as have thus been attained seem to me to be due either to cycles of whose existence the forecaster was not aware or to opposed seasonal weather conditions six months apart. An example of this type of forecasting is the English folklore saying that a moist summer is often followed by a severe winter.

There is an abundance of literature on weather cycles, little of which goes farther back than Schwabe's announcement in 1843 that he had discovered a sunspot cycle of about 10 years between maxima. There is a sunspot cycle of 9.93 years, but it has considerably less amplitude, or sum of extreme departures from a mean, than the cycle of 11.11 years, which is consequently called "the sunspot cycle." Much of the literature on cycles is a rehash. The number of cycle researchers has been surprisingly few, and of these few, only a very few have extensively investigated cycles longer than about 35 years. Yet it is the longer cycles that are responsible for climatic changes such as have produced "dust-bowl" conditions and serious droughts in many regions during the last decade or two.

Man-kept records of weather seldom go back more than about a century, and since most cycle researchers have used only that sort of data, they have seldom attempted to find cycles longer than about a third to half a century. Nor were they very successful in finding the exact lengths of even the short cycles that they discovered. What was worse, those cycles seemed to lack stability, and proved valueless for forecasting purposes because there was no way of telling when "the two-year cycle," for example, would either cease to display itself or would invert its phase, that is, cause a dry spell when a wet spell was due, or the converse.

Long climatic cycles recorded by geological phenomena, on the other hand, show a stability that is remarkable. The vertical spacing of series of ancient beaches around lakes and along seashores proclaims both great amplitude and great uniformity of length of the cycles that caused them. This led me several years ago to devote less time to the study of man-kept records of weather and more time to the study of Nature's records, particularly those of a geological sort.

Meteorologists are usually regarded as the only large group of professional men who have given much thought to weather and climatic cycles; but there is an even larger group who have long been studying cyclic phenomena, namely, geologists. In the Encyclopedia Britannica we read that "The fundamental principle of modern physical geology is that processes in the broad scale work in cycles."

Eleven years ago Professor Charles Schuchert of Yale said: "The idea of the cyclic nature of marine flooding and sedimentation, of course, goes back at least to John Strong Newberry's epochal paper of 1874 entitled "Circles of Deposition in American Sedimentary Rock."

I had the good fortune to be one of Professor Newberry's students, and through him got my first insight into "circles," as he called what are now called cycles. In geology cycles are both diastrophic and climatic, the two being correlated. Diastrophic cycles are rhythmic displacements of the earth's crust, often accompanied by folding on a grand scale.

About the time that Newberry announced his discovery of a diastrophic cycle, another great geologist, James Croll of Scotland, tried to solve the problem of the cause of the Ice Age, which Louis Agassiz, the Swiss biologist, had recently discovered. That grand climatic cycle is so outstanding in its effects that its oft repeated returns are not now questioned. The main questions are those of causation and of the time interval between its maximum effects. Croll attributed it partly to the gyration of Earth's axis and partly to the revolution of Earth's aphelion or its orbital point nearest the sun. About every 21,000 years the earth is farthest from the sun in midwinter, which led Croll to infer that the Ice Age cycle has a length of about 21,000 years. His was the first attempt to estimate the length of any climatic cycle by aid of an astronomical theory. Although he erred as to the cause, he came remarkably close to the length of this grand cycle, because the period of gyration of Earth's axis is a major factor, I believe.

The first successful attempt to find the approximate length of a geological cycle by means of observed facts was that of a British geologist, Prof. L. D. Stamp. He used varves as his time units, and he used the thickness of rock strata deposited between two periods of great folding (two "revolutions") as Nature's record of the length of a sedimentary cycle of great length.

The word varve is new, even to most scientists. Varves are layers of sediment deposited annually in a lake or sea. As tree-rings record annual depositions of wood-fibre, so varves record annual depositions of silt, sand or precipitates like calcium carbonate. That thin layers of clay, usually about ⅛ to ¼ inch thick, were annual deposits in an-

(A paper read October 17, 1940, before the Pennsylvania Water Works Association)

cient glacial lakes was first inferred by a Swedish scientist 170 years ago. But in the observational sciences, new ideas are prone to receive scant recognition for one or more generations; so the varve had to be rediscovered at least three times before anyone began to measure lake varves systematically. That was when De Geer of Sweden began in 1912.

Congenital skepticism as to new discoveries is not confined to geologists. Meteorologists often outrun them in that respect. Not till 400 years after Leonardo da Vinci discovered that tree-rings record rainfall changes did anyone begin to measure tree-rings systematically. And then it was not a meteorologist but an astronomer, Professor A. E. Douglass. Even yet De Geer and Douglass have very few research followers among meteorologists.

Coming back to Stamps epochal achievement in 1926, we find that his varves averaged 184 to the foot, which, multiplied by the number of feet of rock in the Ordovician Period in Burma, gave about 1,700,000 years as its length. My rock varve measurements in western North America, from Canada to the southern end of Mexico, give an average of about 190 varves or years to the foot of rock, and nearly 2,000,000 years as the length of the cycle called a Geological Period or System. Moreover I have found that the maximum thickness of rock in each of the last 15 Geological Periods differs too little from 15,000 ft. to be accidental. The odds are 70 to 1 against such close agreements in thickness by accident. This can mean only one thing, namely that the Geological Period or System is a regular cycle both of crustal movement and of climatic change. For additional facts on this cycle consult an article of mine in the Pan-American Geologist, November, 1939, in which the nature of the erroneous helium-lead formula for finding rock ages is also discussed.

A year after Stamps publication of his estimated length of the cycle called a Geological Period, W. H. Bradley, of the U. S. Geological Survey, determined the length of a cycle of the order of 21,600 years in length. He thought that it might be the celebrated cycle whose length Croll had inferred by aid of an astronomical theory to be 21,000 years. Bradley measured about 500 varves in the oil-shale deposits of Colorado; and he measured the thickness of 16 pairs of alternating beds of shale and marlstone; whence he deduced a cycle whose length was between 16,000 and 26,000 years. Unfortunately the varves in that region vary so greatly in thickness that a close estimate of the length of the cycle was not secured. But Bradley clearly established the length of a cycle comparable to that of the Ice Age Cycle. The term Ice Age Cycle is here used to designate a cycle whose length is I believe, exactly 24,300 years. It has greater amplitudes near peakes of the cycle called a Geological Period or System, and still greater amplitudes near peaks of Geological Ages, there being three such Periods to every such Age. Since the beginning of the Quaternary Age there have been about 13.8 Ice Age Cycles, as is well shown by ancient marine beaches in California whose vertical spacing is about 100 ft. I have published data relative to the length and peak dates of the Ice Age Cycle in the Pan-American Geologist, March, 1939.

Stamp's and Bradley's use of varves and rock strata gave approximate lengths of two very long climatic cycles—too long to be of practical use in forecasting. Engineering is the application of science in the solution of economic problems. Being an engineer, I was seeking to find the lengths of climatic cycles that could be put to economic use. So I undertook to find the lengths of cycles in rock-strata that could be thus used. While it might not be feasible to date the peak of any short rock-strata cycle, it seemed feasible to determine the length of such cycles and to show that cycles of the same lengths exist in the rings of the California sequoias and in the varves of Lake Saki. I have succeeded in this attempt, at least as to several important cycles.

Cores taken from Lake Saki mud have varves that go back to 2300 B.C. when their great thickness for many years indicates very heavy rainfall. This led me to recall that about that time during the Egyptian Dynasty XII, there were hieroglyphic records of flood levels of the Nile, scribed in the rock walls at the Second Cataract, showing floods 24 ft. higher than the highest of modern times; Thus Lake Saki varves confirmed history relative to a very important rainfall epoch, even as Huntington's sequoia ring measurements had confirmed history as to several other very long epochs of climatic changes. Parenthetically, let me urge study of the treatise on "Climatic Changes" by Huntington (a geographer) and Visher (a geologist); and another similar book, "Climate Through the Ages" by Brooks, Secretary of the Royal Meteorlogical Society. The data there given suffice to show that even in historical times very great climatic changes have occurred repeatedly. Brooks is the author of a short but illuminating article relating to climatic changes, namely his article on the Lake Saki varves in "The Me-

Fig. 1—Series of Mexican limestone beds averaging 6 inches thick record the 100-year cycle; and are underlain by another series averaging 18-inches thick that record the 300-year cycle.

teorological Magazine" (London), July, 1935.

The Lake Saki varves indicate a cycle of 1800 years, having rainfall maxima about 2300 B.C., 500 B.C., and 1300 A.D. The last two dates are confirmed by the California sequoia rings.

I began my search for cycles in rock strata in California and later extended it to include six states and Mexico. Rock varves had been said to be rare, but I found them in every region, not in long series, to be sure, but in sufficient numbers to enable me to estimate closely the lengths of cycles recorded by rock-strata. The shorter cycles are usually shown by series of thin beds of rock of nearly equal thickness, as in Fig. 1. Longer cycles may be shown in the same way, but are occasionally shown in a striking manner by a series of alternating beds of two different kinds of rock, as in Fig. 2. The alternating beds may be shale and sandstone, or shale and limestone, or some other paired combination. In the highway cut shown partly in Fig. 2, there are 32 pairs of beds, and the thickness of each pair differs little from 4.5 ft. The varves there average about a trifle less than 1/16-inch thick, so that it took about 200 years to deposit enough sediment in the sea to make a foot of rock. Consequently each of these pairs of beds records the 900-year cycle. At times the 300-year cycle disclosed itself by thinner, intervening beds of sandstone.

In Fig. 1 a series of 6-inch beds records the 100-year cycle; and below them a series of 18-inch beds records the 300-year cycle. Occasionally the 6-inch beds are subdivided into three 2-inch layers that record the Bruckner weather cycle of about 33 years.

It will be noted that the four cycles above mentioned have lengths whose ratios are 3 to 1 in series. These and other facts led me to infer that cycles often occur in harmonic series whose lengths are terms in a geometrical progression series whose ratio is three. Later I found that all cycles occur in such triple-progression series, and there are at least four such series, designated as A to D in the accompanying table of cycle lengths.

Although reasoning by analogy often leads a researcher up a blind alley, it is the most fruitful means of discovering new laws in the observational sciences. Extending the triple-progression law beyond the limits of lengths given in the accompanying table, I was lead to look for a cycle in rock-strata three times that of 900 years. I found such a cycle of 2700 years, and then one of 8100 years. As a result of Bradley's use of varves in pairs of shale and marlstone beds, I knew that a cycle of the order 3 times 8100 or 24,300 years exists. While it has not been feasible as yet to show by measuring a vast number of varves that the cycle is precisely 24,300 years, there is strong probability that that is it's exact length. This probability is enhanced by the fact the length of a Geological Period is nearly 81 times 24,300 years; for 81 is a term in the triple-progression factor. Moreover, Geological Periods or Systems have been subdivided by geologists into 3 Formations, and each Formation into 3 Groups, and each Group into 3 Members, much too often to be accidental.

The particular triple-progression series of cycles above discussed is what may be called the B series, lengths of whose shorter members are given in column B of the accompanying table. As to its longest members the B series is clearly the dominant series. One of its short members is the 11 1/9-year cycle which is so prominent in sunspot numbers and the frequency of auroras. But the 11 1/9-year cycle in weather is so far from being conspicuous that many cycle researchers (e. g. Dinsmore Alter) could find no evidence of it in the rainfall data that they analyzed. Although my analyses of sequoia rings established its existence when averages were taken of a large number (256) of cycles, the amplitude was surprisingly small, being only a trifle more than 2 per cent. Recently, having decided to investigate the reason for so slight an amplitude, I began by analyzing Boston and nearby rainfall after segregating it into four seasons of 3 months. At once it became evident that the 11 1/9-year cycle in summer rainfall has usually had a phase oposed to that of winter rainfall. This was not very surprising because of its analogy to Wagner's discovery in 1924 that the 33-year cycle in Vienna temperature has opposed phases in winter and summer. The net effect is that when winter and summer rainfall are combined, evidence of the 11 1/9-year is often obliterated. While studying this significant fact I observed that phase inversions occurred frequently both in the summer and in the winter rainfall. This suggested that in the case of the California sequoias, which are dependent mainly upon winter snow and rain, there might be such frequent phase inversions as almost to obliterate evidence of the 11 1/9-year cycle when any ordinary method of analysis was applied. Perhaps it is needless to say that I was delighted to find that this analogical reasoning was found to be correct. Hereafter it can not be contended that there is insufficient evidence of a weather cycle having the same length as that of the great sunspot cycle of about 11 years.

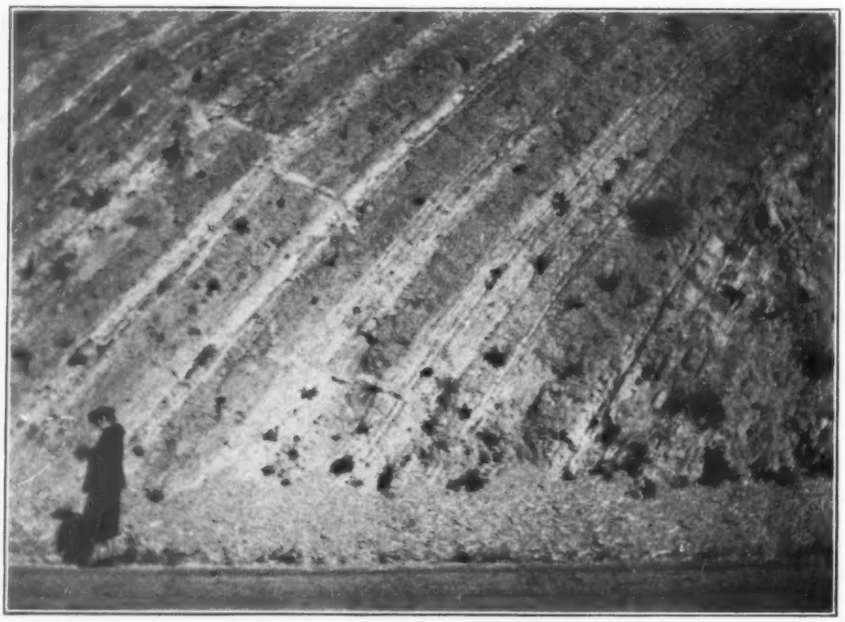


Fig. 2—Alternate sandstone and shale beds, of which 32 pairs exist in this California highway cut, record the 32 of the 900-year cycles.

This discovery has such an important bearing upon the whole theory of cycles that it seems desirable to outline now the method and the results of the analysis of the sequoia rings, even though the thesis of this paper is one relating to long climatic cycles rather than to short weather cycles.

The method of cycle analysis that I use is a slight modification of Balfour Stewart's method of simple averages. It is the most laborious method of cycle analysis but its results are the most accurate; and now it develops that it is the only method that can be used to disclose frequent phase inversions. Since a cycle of 11 1/9-years was under investigation, a blank table of 11 columns was ruled, so that the thickness of an annual tree-ring could be entered in each successive column along a line. From previous analyses of sunspot numbers I had found that this cycle had its last peak in 1938.51, which was also a peak of the 33⅓ year cycle. Hence if there is a rainfall cycle it is harmonic with the spot cycle, and if its length is precisely 11 1/9-years, it had a peak in minus 1094.82 or March 7, 1095 B. C. So the average thickness in 1095 B. C. of the rings of the trees measured by Douglass was entered in the first column on the first line of the table. The thickness of the ring in 1094 B. C. was next entered on that line in the second column, and so on till the line was filled out for the 11 columns. In like manner each successive line was filled out, taking care to remember that when a calculated peak date occurred in the autumn, it would effect tree-ring growth mainly in the following spring and summer; hence the ring thickness for the following calendar year should be entered in the first column.

Each page of the table had about 25 lines, which were totaled. Then each line was inspected to see whether its peak was in or near the first column, or in or near column 5 or 6. If the latter was the case, an inverted phase was inferred. All cycles of inverted phase were segregated from those of direct phase, and the 11 columns were totaled. On the very first page of this table, there were 11 lines or cycles of inverted phase and 14 of direct phase. The mean amplitude of the 11 inverted phase cycles was over 22%, and that of the 14 direct phase was 20%, or an average of 21%; whereas before this segregation the average amplitude of the 25 cycles was only 2.7%! Every one of the

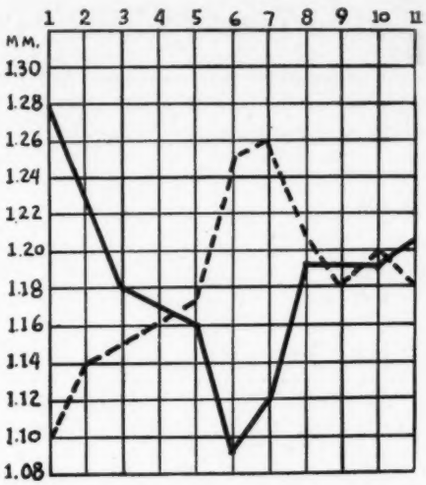


Fig. 3—The 11 1/9-year cycle in thickness of rings of California sequoias or "big-trees" dates back to 1095 B. C. The full-line graph is a mean of 144 of these cycles that have direct phase. The broken line graph is a mean of 142 of these cycles that have inverted phase.

9 pages of the table showed similar results, although the amplitudes of the cycle decreased as the trees became older, as was to be expected. As their roots become deeper and more widely spread, tree growth is less affected by variations in rainfall; and the increasing circumference of the tree as well as its lessening vitality tend to lessen the annual variations in ring thickness; or, as Douglass puts it, the tree becomes more "complacent."

The final result was 144 direct phase cycles having an amplitude of 14.3%; 112 inverted phase cycles having an amplitude of 13.5%; and 256 unsegregated cycles having an amplitude of 2.2%.

The calculated length and peak dates of the cycle turned out to be correct, for the peak was consistently in the first column of the 9 groups.

It has often been contended that the lengths of weather cycles are variable. This analysis, and others like it, prove that cycle lengths are constant or nearly so. Seeming variations in length are caused by other cycles, but when the effects of the latter are ironed out by averaging, constancy of length discloses itself. At San Diego, California, since 1849, the average rain peak has been in January. Yet during the 90 years of this record, there have been years in which the rainiest month was as early as November and as late as March. No one has ever suggested that this range of four months indicates that the basic cycle varies in length from exactly 12 months. Since the cause of the 12-month temperature cycle is well known, any seeming variation of phase or of length is properly ascribed to other factors, e. g. other cycles. By a parity of reasoning we are justified in inferring that all cycles have lengths that are constant, and also that any seeming variation in phase, save the established one of inversion, is not real but a consequence of the existence of other cycles.

Fig. 3 shows graphs of the above mentioned 9 groups of direct and 9 groups of inverted phase tree 11 1/9-years long. No knowledge of mathematical probability is needed to show that this cycle is real. Yet application of a simple rule of probability seems desirable in order to show the over-whelming evidence of the reality of the 11 1/9-year cycle as a weather cycle. Since the dates used in the table of 11 columns were deduced by successive subtractions of 11 1/9-years, starting with a sunspot peak in 1938.51, it follows that there is only one chance in 11 that any one of the 9 groups of direct phase cycles would have a maximum total in column 1 of the table. All 9 groups had their maxima in column 1; and this would occur by accident only once in 11 raised to the 9th power, and 1 in 2,357,947,671 such groups. Hence the odds against such an occurrence by accident exceed 2357 million to one! Enormous though these odds are, still they are but a fraction of the total odds, as can be shown by taking into consideration the valleys of the 9 direct curves.

Upon studying the tree-ring table showing phase inversions of the 11 1/9-year cycle, it became evident that the great majority occurred every other cycle. This, of course, meant that a rainfall cycle of 2 times 11 1/9, or 22 2/9 years, not only exists but is dominant. In "Water Works and Sewerage," November, 1929, and January, 1930, I gave data showing the existence of a cycle of about 22.4 years in both California sequoias and Arizona pines, which I attributed to the fact that sunspots reverse their direction of rotation and magnetic polarity about every 11.2 years. My recent and more painstaking method of analysis of these and other tree-rings gives a slightly less length or, to be exact, 11 1/9 years. I now see no better basic reason for these phase inversions in rainfall than the one given 11 years ago, but in the interim I have come to the conclusion that the sun emits electrons that

bombard the earth and cause not only cyclic weather changes but many other correlated cyclic phenomena, such as earthquakes, changes in sea-level, very slight changes in the length of the year, marked changes in declination and dip of the magnetic needle, auroras, etc.

Since electrons moving in a magnetic field tend to spiral around a magnetic axis, it follows that those moving in magnetic fields caused by sunspots must change their direction of spiral motion every 11 1/9 years as a result of the Hale cycle of twice that length in sunspot polarity. But when these electrons change their direction of spiral motion they also change their magnetic polarity. When they reach the earth they are attracted by magnetic foci in the earth, having polarity opposite to theirs, and are repelled by foci having polarity like theirs. The result is that in any given region, solar electrons are most attracted every 22 2/9 years, and in the same region are most repelled 11 1/9 years later.

Not only do electrons act as condensation nuclei of atmospheric moisture but their movement causes atmospheric currents. Moreover, they magnetize the oxygen, which comprises one-fifth of the air, and thus not only cause atmospheric tides, but build up local electromagnets in the air, in which the magnetized oxygen is the core and the electrons spiraling around it constitute the electric current.

Incidentally, the 12-hour cycle of barometric rise and fall ceases to be puzzling when it is realized that streams of solar electrons act upon the oxygen magnetically, much as the sun's gravitative attraction acts upon it, but with greater force than the latter.

For the same reason that there is a weather cycle twice as long as the 11 1/9-year sunspot cycle, every other solar cycle in the B series is correlated with a weather cycle of just twice its length. Thus there is a solar cycle of 33⅓ years and a rainfall cycle of 66⅔ years. And, as stated in the footnote of the table, the lengths of all cycles in the table must be doubled to get the lengths of the correlated rainfall cycles.

Study of the table shows why there was a long period of recurring droughts near the close of the 18th and the beginning of the 19th centuries, followed by a long wet period that had its peak about 1869, since which the trend of the rainfall curve has been downward and that of the temperature curve upward. The 200-year cycle of the B series is one of the main causes of the present declining rainfall and rising temperature, which will continue another 65 years. It is being strongly aided in reducing rainfall by the 162-year cycle of the A series, which will have a maximum of dryness in 1950, and by the 178.8-year cycle of the D series, which will reach the climax of its dry effect in 1946, and by the 36.74-year cycle of the C, whose dry maximum will occur in 1948.

TABLE OF LENGTHS AND DATES OF CYCLES

	A	B	C	D
Days	4.51	5.57	9.20	4.98
	13.53	16.71	27.61	14.93
	40.58	50.10	82.82	44.80
Months	4.00	4.94	8.16	4.42
	12.00	14.82	24.49	13.25
	36.00	44.44	73.47	39.74
Years	9.00	11.11	18.37	9.93
	27.00	33.33	55.10	29.80
	81.00	100.00	165.31	89.41
Date of Maximum	1869.18	1905.18	1746.00	1857.10

Footnote: The date of maximum at the bottom of each column applies to every cycle whose length is given in that column. These lengths apply to sunspot and auroral cycles. The lengths of weather cycles (other than the 12-month cycles) are double the lengths given in this table, and there is also a minor 24-month weather cycle.

Were it not for other cycles, the 200-year cycle and its subcycles would cause repetitions of the same seasonal weather every 200 years. Since it is a very powerful cycle, it has often happened that the rainfall of a given season in the 18th century has been paralleled quite closely in the 20th century. Unfortunately, American rainfall did not begin to be recorded regularly till 1738 at Charleston, in 1749 near Boston, and nowhere else in this continent till 1804 at New Haven, Conn.

As Kincer and others have pointed out in recent years there has been a long downward trend in the rainfall curve that has been particularly marked in our northwestern states. Gagings of the Columbia River go back only to 1880, and they show this downward trend strikingly. New England rainfall shows it also since about 1870. Tree-rings of eastern Oregon have been measured back to 1268 A. D., and during no time during that span of almost 700 years has so long and so severe a drought been recorded by them as the one that began in 1917. Since then those rings have had a thickness only two-thirds of the previous average!

The Mammoth Hot Springs Hotel in Yellowstone Park has been closed because the springs have almost ceased to flow, and many of the geysers of that region have ceased to spout. These are unprecedented occurrences that find their parallel in greatly reduced runoff in many of the streams that feed the Colorado River.

The Gila River in Arizona is delivering so little water that the Cooldige Dam is at present a useless structure. As I looked upon it recently I wondered whether a similar fate might visit Hoover dam on the Colorado within the next 20 years.

The hotels in the city of Mexico are telling the guests to use as little electric light as possible, because the hydroelectric plants face a water shortage. That is the ancient city that was "a veritable Venice" when Cortez conquered it in 1519. Significantly enough the 200-year cycle had a rain peak in 1505. That long rainy period in Europe was strikingly marked by the greatest recorded flood of the Danube in 1501; and it is significant that the greatest recorded flood of the Mississippi was 42 years later. The latter flood was seen by DeSoto in March, 1543, and he was told by the Indians that similar floods had occurred at intervals of 14 years. It is also significant that one of the three highest peaks in the curve of numbers of Chinese earthquakes that date back to 240 A. D. was about 1500 A. D.

I have written several articles outlining an electron theory of the cause of weather and climatic cycles, and expect to write several more; so this important subject will be touched upon now only to add that evidence becomes increasingly persuasive that cyclic bombardments of the Earth by solar-electrons are causes of all types of terrestrial cycles. The sun bombards the Earth with photons that cause light and heat. It

also bombards us with electrified corpuscles that cause auroras and magentic storms, as all authorities now agree. Eventually they will also concur in regarding solar electrons as causes of all types of terrestrial cycles; for correlations of all types of cycles makes no other theory tenable.

The discoverer of the elecron, Sir J. J. Thomson, died a few weeks ago, but not until he had seen electronic theories revolutionize almost every branch of physics. The physics of the air, the physics of the Earth's crust and the physics of the magma beneath it are not likely to escape a similar revolution.

SAFE LOADINGS FOR I-BEAMS*

How Much Will Any I-Beam Hold?

The accompanying chart answers the above question, which has been asked by many a water works man. No computations are necessary. The chart tells how much any ordinary I-Beam will hold under the very *worst* condition, with the load concentrated in the middle of the span as shown by the sketch on the chart. The chart, for the sake of safety, is based on concentrated loading.

Let us suppose that a weight of 4,000 lbs. must be supported in your plant. A 7-inch I-Beam, weighing 240 lbs., is available. It is 12 feet long, and therefore weighs 20 lbs. per foot. The minimum distance between supports that can be obtained for the lifting operation is 10 feet. Is the I-Beam strong enough to lift the 4,000-lb. load?

The Answer

The dotted lines drawn across the chart show how the problem is solved. Run a straight line through the 10-ft. (column A) and the 20-lb. (column B) and locate the intersection in column C. Then, from that intersection in column C, run over to the 7-in. (column E). The intersection through column D shows that the I-Beam will support 7,000 lbs. Since the load to be lifted is only 4,000 lbs. the beam is amply strong. In fact, the reader can easily find, by applying the chart, that a 4-inch I-Beam, all other conditions being the same, would safely support the load of 4,000 lbs.

Similarly, it is easy to ascertain the maximum allowable span when the factors in columns B, D and E are known. Or, the necessary weight per foot of I-Beam may be determined when the factors in columns A, D and E are known. Lastly, the depth of beam is determinable when the factors in columns A, B and D are known.

For loads that are "uniformly distributed" — not concentrated — the safe loads in column D may be multiplied by two. Thus, the above described beam will support a uniformly distributed load of 14,000 lbs., or 1,400 lbs. per running foot.

*Contributed by W. F. Schaphorst, Newark, N. J.

DANGER—SLOW MEN WORKING

An Open Letter From One "Super." to Another

Roanoke, Va.
Sept. 1, 1940

Dear Bill:

During your peregrinations (what a word—Ed.) about the country you have probably often observed warning signs on the highways and streets that read (you have guessed it—its travels or roamings—Ed.).

DANGER
SLOW
MEN
WORKING

I have long since reached the conclusion that the phraseology of these signs is not as foolish as one might think on the spur of the moment. They make you think twice, and any warning device that makes you think twice has reached some kind of acme or zenith of effectiveness.

A similar device that I often notice, with some admiration, is the device consisting of several pieces of sash cord hanging over and across railway tracks and placed near either side of bridges in railway terminals. Bill, these devices, in my humble judgment, are masterpieces. They make the brakeman or flagman who is strolling along on top of a moving box car "duck." I often think that it would be well if there had been such devices to have caused many of us to have "ducked" in time to have avoided situations that we sometimes become involved in, that are dangerous, costly, or useless. I am also beginning to believe that there are many instances in our regular routine operations that we are inclined to take too much for granted and where warning signals could be placed that would save us material amounts of time, inconvenience and money. Sometimes we are like the fly on a large photograph—we are too close to the picture to get the proper prospective.

I hope that this apparent display of psychology has not led you to believe that I am going academic or pedantic, but the thought that I have in mind is the unintentional destruction of small valves.

Your Valves Are Right
Your Tools Are Wrong

You mentioned in your last letter that your maintenance of small valves was out of reason and that you were considering changing to some other make. Can't understand that, because the valve that you are using is considered one of the best manufactured. We all have various quantities of 1½ inch and 2 inch valves in our distribution system, and I can assure you that the fault lies not in the quality of the valve that you are using but in your valve specifications. Your trouble, like many others, lies in the fact that your small valves are equipped with square operating nuts. None of us can remember the size of every valve on every corner in our system, and certainly it is too much to expect that all of your laborers will remember these details. When two six-foot "niggers" set a big heavy valve key on the square operating nut and begin to turn the key, something often happens, and it isn't always funny. On the other hand the laborers in question should not be censured, because usually nothing is exposed in the valve box but the operating nut, and often it is necessary to clean accumulated dirt from the box to expose even that, and there is nothing whatever to indicate the size of the valve.

If you will replace the square operating nut on each of your small valves with a small hand wheel and furnish your maintenance crews with a valve key made of ⅝ inch or ¾ inch round steel with a forked end designed to fit into the spokes or holes in your hand wheel, I believe your small valve troubles will end.

Thereafter whenever your laborers, regardless of their degree of intelligence, have occasion to operate a valve and find a hand wheel on it, they are immediately warned that this is a small valve and should be operated with some degree of caution and care.

Bill, we have been using this scheme for twenty years, and I can assure you that it works admirably. Because of it, we seldom have a broken 1½ inch or 2 inch valve stem.

I shall be happy to hear from you soon and to learn if this bit of humble advice helps you any with your valve maintenance problem.

Sincerely,

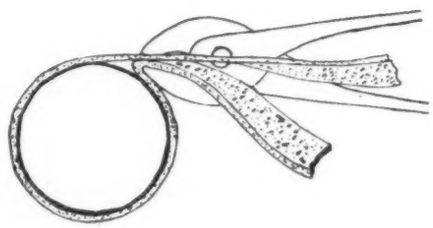
"Doc"*

*D. R. Taylor, Plant Sup't., Roanoke, Va.

Twisting Kink*

When it comes to twisting "slippery round things," as the water and sewage operators often must, the accompanying sketch shows how easy it is to make a good "wrench" out of a leather or woven strap and a pair of pliers. Wrap the strap around the article to be turned, as shown, and grasp close to the article with the pliers and use them as the turning lever. Most of you have used chain tongs for holding or turning pipes. The principle is the same in this case.

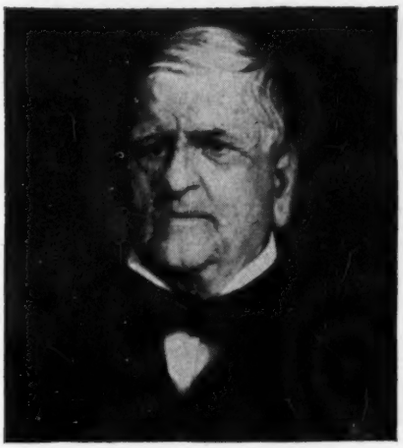
This idea is of especial value where the leather forms a cushion between the pliers and the metal. If it is thought that a single thickness of



leather will not be strong enough it is a simple matter to use two thicknesses or more. Thus the method really has no size limit, provided one has a strap that is long enough. What is more, any strong flexible material will do—even rope.

To be sure, for pipe work a regular pipe wrench is better, because pipe wrenches are made specially for the purpose, and one can more easily develop a powerful twisting action through the handle of a regular wrench. Nevertheless, it is well to know about this kink, as we often find ourselves confronted with a job that we think needs a pipe wrench, whereas with a pair of pliers and an ordinary strap the obstacle may be easily overcome. In addition this "pipe wrench" will not mar the shaft or tube being turned.

*Contributed by W. F. Schaphorst, M.E., Newark, N. J.



SALT OF THE EARTH

Fifty years ago a man sat in a Pittsburgh office and pondered a need. He was Captain John B. Ford, father of the plate-glass industry in America. His need was for soda ash. Out of this need, and out of an irresistible urge to take the basic raw materials of the earth and translate them into useful products for the service of mankind, he decided to found a chemical company.

It was a venture into a new field. Captain Ford was eighty years old. In the course of a long life he had applied his creative powers to the manufacture of many needs for a growing country: saddles for the American Army in Mexico, ships for commerce on the Ohio and the Mississippi, iron and steel for a rising industrial nation. . . . He had not only manufactured thousands of tons of plate glass, but he was the first to polish plate glass successfully . . . to make it commercially practicable.

Now he would seek other raw materials: salt, limestone and coal. He would combine them chemically and produce his own soda ash for his glass factories. He would be independent of all sources of supply. . . . Most important of all, he would be turning his restless energy to fresh fields.

Here was a challenge: Captain Ford met it characteristically. He purchased twenty acres of salt beds along the Detroit River in Wyandotte, Michigan, and there began the production of brine. On these twenty acres he built his first small soda-ash plant. . . . He called it the Michigan Alkali Company.

When Captain Ford drilled his first salt well in 1890 he knew that the brine pumps would be working after his time. What he could not know was that fifty years later, in 1940, the wells he drilled would still be producing night and day . . . that instead of 20 acres and 10 wells there would be 300 acres and 50 wells . . . that more than 42 miles of piping would be needed to supply one of his plants alone . . . that more than 40 million gallons of water would be used every day . . . that his Michigan Alkali Company would become one of the great basic chemical companies of the world, manufacturing a wide range of different products, serving more than 50 different industries.

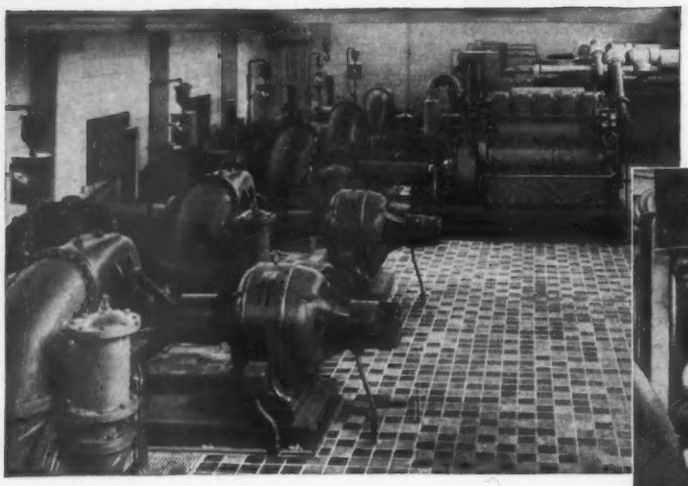
On its fiftieth anniversary, the Michigan Alkali Company can pay no more just tribute to its founder than to say that Captain John B. Ford builded better than he knew . . . that from his day to this, his company has continued in ever-increasing ways to translate raw materials, among them the salt of the earth, into useful products for the service of mankind.

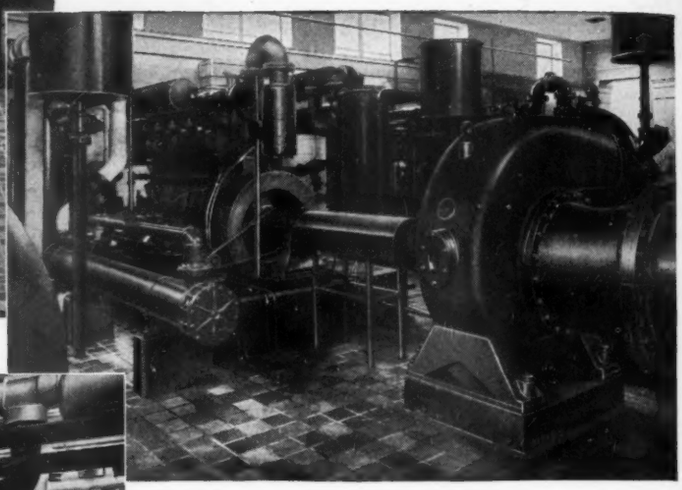
50th ANNIVERSARY 1940

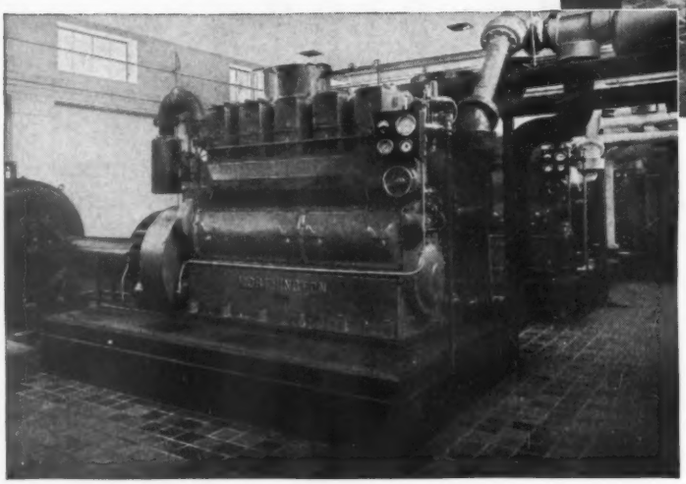
MICHIGAN ALKALI COMPANY

WYANDOTTE, MICHIGAN

SODA ASH • CAUSTIC SODA • BICARBONATE OF SODA • CALCIUM CHLORIDE • DRY ICE • LIQUID CHLORINE
CALCIUM CARBONATE • COKE • CEMENT • TAR • TOLUOL • BENZOL • XYLOL • CALCIUM HYPOCHLORITE







AT GARY, INDIANA . . . Three Worthington 24 inch centrifugal pumps, each of 20 MGD capacity, 35 feet TDH, driven by Worthington 175 hp. engines operating on sewage sludge gas. Also, two Worthington 20 inch centrifugal pumps of 15 MGD each capacity, driven by 125 hp. Ideal Electric Company synchronous motors. An installed capacity of 90 MGD, for handling raw sewage.

WORTHINGTON EQUIPMENT for SEWAGE DISPOSAL NOW SERVES GARY, INDIANA . . .

as well as scores of other forward-looking communities.

Recent notably successful installations of Worthington engines for operation on formerly wasted sewage sludge gas, have strengthened the leadership which this organization has established in the pumping of sewage and in steam power service. There are now installed and on order, 64 units, a total of 18,262 horsepower of Worthington sewage sludge gas engines.

The application of Worthington units to varied sewage plant services offers important advantages . . . undivided responsibility, time-proven reliability at vital points, and substantial operating economies.

WORTHINGTON

EQUIPMENT FOR WATERWORKS AND SEWAGE PLANTS

CENTRIFUGAL PUMPS
for raw sewage and sewage sludge
STEAM AND POWER PUMPS
TURBINE WELL PUMPS
SUMP AND DRAINAGE PUMPS

SEWAGE GAS ENGINES
DIESEL ENGINES
CONVERTIBLE GAS-DIESEL ENGINES

MOORE STEAM TURBINES

STEAM CONDENSERS
CONDENSER AUXILIARIES
FEEDWATER HEATERS
PRESSURE FILTERS
WATER METERS

STATIONARY AIR COMPRESSORS
PORTABLE AIR COMPRESSORS
ROCK DRILLING EQUIPMENT
CONSTRUCTION AIR TOOLS

MULTI-V-BELT DRIVES

WORTHINGTON PUMP AND MACHINERY CORPORATION

General Offices: **HARRISON, NEW JERSEY** *District Offices and Representatives in Principal Cities*

ICO-41

ARE THERE ANY FIFTH COLUMNISTS IN YOUR WATER PLANT?

By HUDSON NIX*

In submitting this discussion for publication the author comments by letter:

"I am only an operator in the water purification plant of The Tubize Chattilon Corporation here in Rome. However, the context of this article has been suggested by problems of plant operators that have come to my attention at conventions and short schools."

"Lest the reader may come to the opinion that the author is himself a "Fifth Columnist," I should like it known that the full context of this article was first discussed with my present superior, and with the former superintendent of our plant, and, with the viewpoints and arguments presented herein, both are sympathetic.—H. N."

With the author's considerations and viewpoints we, too, are sympathetic. And, in as much as this contribution is of the essence of an editorial—and a well composed one—we are pleased to concede it editorial position in this issue.

THE water works official, as a rule, is unselfish and conscientious. He wants to give his city or company the best he is capable of delivering. He wants to please customers and he desires to contribute something to the field from which he has drawn so heavily in knowledge and information. He has a full-time job at home, yet he is obligated to share in the experience and experiments of others in his state and the country as a whole. Sometimes I think if he is not careful, he will be drawn too far from his own plant, and may lose sight of his employes' thoughts and viewpoints.

This is not a circuitous dig at either of the two superintendents I have worked under. It is not suggested by any specific experience connected with my particular job. My relations with both my former and present superior have been entirely satisfactory, and I am permitted to number each among my best friends. But from experience and observation I do know that the operator's viewpoint and position is frequently overlooked, and I know enough about a water plant and about human nature to sense the danger in such an oversight. It may undermine the very foundation upon which good public relations are built.

Confidence and Good Will

The superintendent who fails to maintain the confidence of the men working under him will fail in his attempts to hold the good-will of the public. The superintendent can annihilate the respect of his operators by a few insincere statements, a selfish gesture or two; or, he can do it by neglect of the operator's problems which should receive his attention. He can do it by dashing to the front to receive alone all the credit for worthwhile accomplishments and then passing the buck when things go wrong. The operator may accept this type of supervision in a docile enough manner, but underneath he is not fooled, and a smouldering resentment against his superior is born.

The average operator doesn't mind being bossed by a leader, but he resents being driven by a stuffed-shirt. He doesn't question the superiority of the superintendent's ability, training and knowledge, but he is aware that the city or company pays not only for the superintendent's service and knowledge but also for what the operator knows and does. And he knows that the combined knowledge of the operator and superintendent is greater than the knowledge of the superintendent alone. The official who forgets this is paving the way for his own undoing.

Consider for a moment the position of the operators. Who has the responsibility for keeping the wheels turning on Sundays, at night and on holidays? Who receives the brunt during floods, ice storms, freezes; when filters must be cleaned, motors and pumps overhauled, or when chemical feed lines break or clog? You'll reply that this is merely the operator's job. Certainly. But isn't it a rather important job?

Rules Have Limitations

Rules are as important and disciplinary measures are as necessary in a water plant as they are in school, but the water superintendent must learn the limitations of rules, as good teachers learned long ago. Your rules will cover only routine situations, while friendship and merited respect and loyalty will spur the operator to efforts in emergencies and in preventing complaints that are not called for in the rules. A football coach or an army officer would understand what I mean. The operator who has the right feeling for his superior will render the extra attention to details that a carpenter gives to a house he is building for a good friend. For our friends or for a cause—whether it be democracy or water plant efficiency—we will contribute efforts that are not specified in the rule book or contract if we are encouraged in the feeling that our efforts will be properly identified with the success of the undertaking. The water system has an obligation to every citizen of the city or town, and every employe from the head to the janitor must perform his duties conscientiously if the system fulfills this responsibility. And when this is done properly, there is credit and glory enough to go around

*Filter Operator, Rome, Ga.

among all who had a part in making it possible. The head of the plant should remember this.

What the Superintendent Can Do

What, then, can the superintendent do to promote the proper spirit among those who work for him? He can avoid favoritism and he can see that merit is rewarded when he has vacancies to fill. He can be open and frank and avoid keeping his men in doubt as to how he wants things done. He should be able to give definite instructions concerning any job that he asks his men to do, and he should be man enough to take the blame if his ideas fail to work when carried out properly by the operator. He can encourage initiative among his men, and he can respect the opinions and ideas that result from the other man's experience. He can give sincere consideration to the requests, problems and difficulties of his employes, avoiding the I-am-too-busy-and-important-to-be-bothered attitude. He can remember that a problem that seems only trivial to him may become enormous to the operator who contends with it first hand.

He can be prompt, fair and open in settling disputes among his men. He may turn on his practiced and synthetic charm and bow out of his office a disgruntled and unreasonable customer, but he should not try anything but fairness and sincerity upon the men who know him well enough to instantly detect a Dale Carnegie act. For no man likes to feel that he is working for a faker. It is only reasonable to resent having to respect as a superior a man who is not sincere, not big enough for his job. An operator may continue to work for a little boss, realizing what payday means to his family; but he is not likely to be any more efficient than he is forced to be. His interest and enthusiasm is not in his work, and his dissatisfaction begins to assert itself in his home and among his friends.

Consciously, or unconsciously, he becomes a fifth columnist. He talks to his wife; he may not intend to damage his superior's reputation, but his feelings and thoughts will crop out, and this may be the spark needed by the opposition gang on election day. A slight criticism that he may make can easily grow into a rumor that he would not recognize after it has been repeated a few times. There is always a greedy politician or a dissatisfied customer who is ready to believe and repeat the worst about a public utility; the dissatisfied worker can easily lend credence to a vile smearing campaign.

Unreasonable?

You may say that this attitude is unreasonable and that such an operator is not worthy of a job. There is reason in your point of view, but such reasoning overlooks the problems arising out of the natural and incurable cussedness in human nature. We're all human, and the wise superintendent will reckon with these problems with the same care and thought that he devotes to his problems in chemistry and engineering.

The answers to these problems are not in the book, nor can they always be solved by the advice of experts in the field of public and industrial relations. These problems grow out of individual situations and peculiarities, and it takes the sympathy, cooperation and concerted efforts of all the individuals in the plant to solve them.

The goal we should seek in our working relations is the opposite of an idea illustrated in a recent *Collier's* humorous cartoon, which pictured two men sitting in front of a hunter's cabin watching a third man walking down the hill. One of the sitters remarks: "In a few steps old Lem is goin' to land in a bear trap—which ain't none of my business!" We should not only "watch our step" but also help those working with us, and for us, to avoid the "bear traps" in our work paths to which the best and most efficient of us are sometimes blind.

First Sewage Convention of National Scope Sets Another Milestone

A Sewage Works Federation of National scope and meaning has now passed the budding stage and all but burst into full blossom during the successful First Annual Convention of the Sewage Works Federation which made sewerage history in Chicago—the birthplace of the Federation—October 3rd to 5th.

The Chicago convention literally began to hum from the very opening gong and lost none of its tempo throughout the three days of studious attendance of sessions, attention to exhibts and demonstrations, play and recreation—all to make the most perfectly balanced meeting of those interested in sewerage ever to be staged on American soil. As recounted in the report covering the convention, elsewhere in this issue, the attendance ran above the 600 mark and the buzzing exhibit hall housed interesting and educational exhibits and demonstrations of 55 of the most progressive firms doing business in the sewerage field.

It is to be noted that the convention is referred to as the *First* Annual Convention of the Sewage Works Federation, for there no longer exists any doubt that there will be a Second in 1941, and we have no doubt that 1992 will not witness the Federation's Fifty-second Convention.

Upon passage of resolutions by the memberships at large on the closing day of the convention, endorsing unanimously the "principle, spirit and intent of a strengthened Federation," and recommended to the Board of Control that "favorable action be taken on the proposed constitutional changes making possible a Federation of National scope," this Board voted that there be held a Second Annual Convention in October, 1941—the location, headquarters hotel, and dates to be selected and announced at the January, 1941, meeting of the Board.

After much detailed consideration of the proposed Constitution and By-Laws, by the Board, it was decided to revamp these in certain directions and submit the final draft for ratification and adoption in January. Since the writing of the convention report, referred to in this issue, a revision of the scale of membership dues, there stated, has been proposed, in as much as the suggested scale seemed neither democratic in principle nor sufficient to produce the funds required for proper and most effective operation of a National Federation.

Notwithstanding the proposed revisions in scale of membership dues the new Constitution, in one or another form, seems certain of complete ratification in January, 1941, whereupon a National Secretary will be employed, a Second Annual Convention arranged for, and, the vitalized and self-supporting Sewage Works Federation will have become a reality, and another milestone of progress will have been added to the history of sewerage and sewage treatment.

PUTTING A PENSTOCK DOWN SO CAPACITY STAYS UP

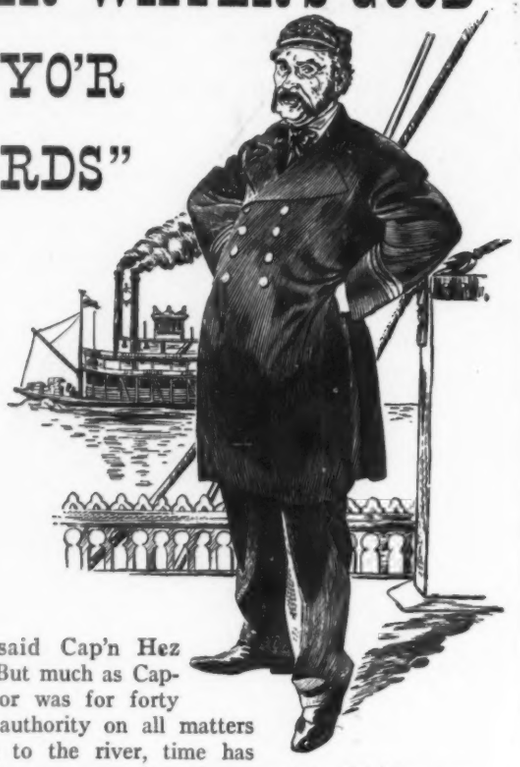
• Here's a pipe line that engineers know will have a long useful life at initial capacity—because it is coated and lined with Barrett Waterworks Enamel. This durable protective surface, made from the most stable bituminous substance known for pipeline protection, defies water absorption, is highly dielectric and resists mechanical distortion. It provides a glass-smooth interior lining to maintain a high coefficient of flow. Because Barrett quality plus the supervision of expert Barrett-trained field men assures you all these advantages, it's sound engineering to specify Barrett Waterworks Enamel.

THE BARRETT COMPANY, 40 RECTOR STREET, NEW YORK, N. Y.

FIELD SERVICE— *Our Waterworks Service Department and Field Service men will gladly provide engineers using Barrett Enamels with* both *technical and on-the-job help. We invite inquiries.*

Barrett
WATERWORKS
ENAMEL

"A DRINK O' RIVER WATER'S GOOD FOR YO'R IN'ARDS"



"So said Cap'n Hez Taylor*. But much as Captain Taylor was for forty years an authority on all matters pertaining to the river, time has proven him wrong—at least in respect to drinking raw river water.

But in Captain Taylor's day, they didn't have an abundance of good microscopes, or Captain Taylor might have viewed with his own eyes the very life that brown river water usually supports—and reshaped his philosophy accordingly.

Nor in Captain Taylor's day did they have abundant Liquid Chlorine for water purification. And although a number of hardy souls probably did survive after taking their river water "straight," there were undoubtedly a number of weaker ones who didn't, and no one knew why.

Today, we at least know some of the answers concerning "good" and "bad" water . . . and Liquid Chlorine is one of them. And today there are many engineers who know the answer to Liquid Chlorine problems.

They know that SOLVAY LIQUID CHLORINE does the job . . . that Solvay Liquid Chlorine at once fills the bill for quality, service, and technical assistance. . . . Write to Solvay on any problem you have concerning Liquid Chlorine.

*A fictitious name.

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MEETINGS SCHEDULED

Oct. 16-19—ATLANTA, GA. (Georgia School of Technology)
Georgia Water and Sewage Association. Sec'y., Paul Weir, 1210 Hemphill Ave., Atlanta, Ga.

Oct. 16-17—SPRINGFIELD, MASS. (Hotel Kimball)
New England Sewage Works Association. Sec'y.-Treas., LeRoy W. VanKleeck, State Dep't. of Health, Hartford, Conn.

Oct. 16-18—ATLANTIC CITY, N. J. (Haddon Hall)
Pennsylvania Water Works Association. (45th Annual Meeting.) Secretary, F. Herbert Snow, 507 Telegraph Bldg., Harrisburg, Pa.

Oct. 18-19—ATLANTIC CITY, N. J. (Madison Hotel)
New Jersey Section A.W.W.A. Sec'y.-Treas., C. B. Tygert, Box 178, Newark, N. J.

Oct. 17-18—MITCHELL, S. D. (Hotel Widman)
South Dakota Water & Sewage Works Conference. Secretary, W. W. Towne, Pierre, S. D.

Oct. 21-23—LEXINGTON, KY. (Hotel Lafayette)
Kentucky-Tennessee Section A.W.W.A. Sec'y.-Treas., H. D. Schmidt, State Dept. of Health, Nashville, Tenn.

Oct. 22-23—SPRINGFIELD, ILL.
Illinois Water Works Operators (Annual Fall Meeting.) Secretary, C. W. Klassen, Department of Public Works, Springfield, Ill.

Oct. 23-26—LOS ANGELES, CALIF. (U. S. Grant Hotel)
California Section A.W.W.A. Secretary, Burton S. Grant, 207 S. Broadway, Los Angeles, Calif.

Oct. 24-25—SPRINGFIELD, MO. (Colonial Hotel)
Missouri Water & Sewerage Conference. Secretary, Warren Kramer, State Board of Health, 200 Monroe St., Jefferson City, Mo.

Oct. 24-25—TORONTO, ONT. (Royal York Hotel)
The Canadian Institute on Sewage Sanitation. Sec'y.-Treas., A. E. Berry, Dept. of Health, Parliament Buildings, Toronto, Ont.

Oct. 24-26—HUNTINGTON, W. VA. (Prichard Hotel)
West Virginia Section A.W.W.A. Sec'y.-Treas., J. B. Harrington, Dept. of Health, Charleston, W. Va.

Oct. 28-30—RALEIGH, N. C. (Sir Walter Raleigh Hotel)
North Carolina Section A.W.W.A. Sec'y-Treas., R. S. Phillips, 319 E. Trinity Ave., Durham, N. C.
(Meeting jointly with)
North Carolina Sewage Works Association. Seretary, M. F. Trice, State Board of Health, Raleigh, N. C.

Nov. 7-8—ST. PAUL, MINN. (Hotel St. Paul)
Minnesota Section A.W.W.A. Sec'y.-Treas., R. M. Finch, W. & T. Co., 416 Flour Exchange, Minneapolis, Minn.

Nov. 7-8—WILMINGTON, DEL. (Hotel Du Pont)
Four States Section A.W.W.A. Sec'y.-Treas., Carl A. Hechmer, Washington Suburban Sanitary Dist., Hyattsville, Md.

Nov. 7-9—AMES, IOWA (Iowa State College)
Iowa Sewage Treatment Conference. Sec'y.-Treas., L. J. Murphy, Iowa State College, Ames, Ia.

Nov. 12-13—PITTSBURGH, PA. (William Penn Hotel)
Water Conference (Engrs. Soc. Western Pa. and W. Pa. Section A.S.C.E. Sponsors). H. M. Olson, Water Conference Chairman, 171 Longue Vue Drive, Mt. Lebanon, Pittsburgh, Pa.

Nov. 13-15—OMAHA, NEB. (Fontenelle Hotel)
Missouri Valley Section A.W.W.A. Sec'y.-Treas., E. L. Waterman, Univ. of Iowa, Iowa City, Ia.
803 Water Board Bldg., Detroit, Mich.

Dec. 2-5—NEW YORK, N. Y. (Hotel Astor)
American Society of Mechanical Engineers. National Secretary, C. E. Davies, 29 W. 39th St., New York, N. Y.

Dec. 12—MEXICO, ME.
Maine Water Utilities Association. Sec'y.-Treas., Earle A. Tarr, Winthrop, Me.

June 22-26—(1941)—TORONTO, ONT. (Royal York Hotel)
American Water Works Association. Annual Convention. Secretary, Harry E. Jordan, 22 E. 40th St., New York, N. Y.

LITERATURE AND CATALOGS

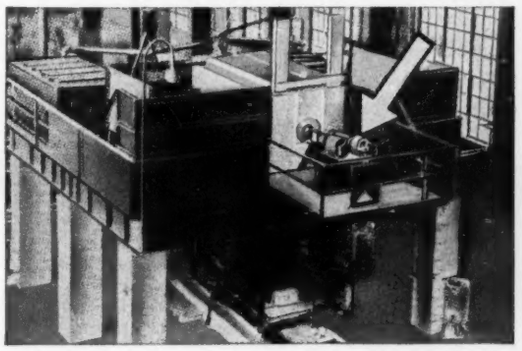
Cast Iron Pipe in Sewerage Systems is a very handsome and expensively produced brochure of 52 pages published by the Cast Iron Pipe Research Association. At least half of the pages are devoted to splendid pictures of adaptation and installation of Cast Iron pipes in sewerage systems and treatment plants. The author of the story—"Cast Iron Pipes in Sewerage Systems"—is no less an authority than Lloyd M. Johnson, Engr. of Maintenance and Operation, Sanitary District of Chicago, who outlines the adaptation of Cast Iron pipe contributory to its increasing use in sewage treatment—the degree being to about 90 per cent of all pipe used in treatment works. The many adaptations are illustrated by excellent photographs collected here and there. An impressive number of these show sewers constructed under all conditions (in fact the toughest) with Cast Iron pipes for dependability and permanence. In the rear of the brochure appears "Reasons Why" Cast Iron pipe is the economical material for sewers and treatment works. In a closing paragraph by Thos. F. Wolfe, Research Engineer of the C. I. Pipe Research Assn., he states that "The purpose of the book has been to demonstrate pictorially, with a minimum of text, the wide application of Cast Iron pipe to sewer and sewage treatment works requirements." That such an attainment has been reached is thoroughly evidenced by the resultant production. In examining its pages one can but be impressed with the great number of treatment plants constructed in recent years and this noteworthy new market for Cast Iron pipe. Those who "rate" a copy of this brochure should request it on their own or company letterheads, since we understand the edition is limited. Address The Cast Iron Pipe Research Assn., 122 South Michigan Ave., Chicago.

Sewage Aeration by Air Diffusion. This 24-page booklet is properly labeled "20 Forceful Facts." Space does not permit listing all twenty, but we note the following as characteristic: 1—The utilization of diffuser tubes makes small sewage aeration plants practical, economical; 4—Auxiliary pre-aeration enhances trickling filter values; 6—Activated sludge plants equipped with gas engines using digester gas to drive air blowers are lowest in cost of operation of all types of complete treatment installations; 10—Experience proves soundness of activated sludge treatment using porous diffusers; 14—Aeration by air diffusion is the lowest cost biological treatment; 20—Wide distribution of air bubble diffusion gives most efficient aeration. A separate page is allotted to a brief exposition of each of the twenty facts, photographic or diagrammatic illustrations, or both, being included in every case. "ALOXITE" Brand diffuser plates and tubes are featured. The booklet, "Forceful Facts on Sewage Aeration by Air Diffusion," may be obtained by aplication to The Carborundum Company, Niagara Falls, New York.

"Kennedy Valves, Fittings, Hydrants" are presented in a new 240-page cloth-bound catalog just published by The Kennedy Valve Manufacturing Co. The catalog is characterized by large illustrations throughout, and has several unique features for convenience in use. For example, in the section on iron-body valves, dimensions and prices of valves and accessories are

Reduce WATER LOSS TO THE MINIMUM WITH "Shatter-Proof" STEEL PIPE

STEEL PIPE practically eliminates water loss. STEEL PIPE comes in long lengths, reducing the number of joints. Because STEEL PIPE has extreme ductility, flexibility and high tensile strength, it withstands water hammer and vibration. The use of "shatter-proof" STEEL PIPE, Lined and Coated-and-Wrapped by the HILL-HUBBELL "factory process," is the modern way of transporting water.



All our work is done MECHANICALLY—INDOORS. Illustration shows Kettle with Mechanical Agitator—Automatic Temperature Control prevents overheating of coating materials.

Get Your Copy

The Book of PIPE PROTECTION describes in detail how "shatter-proof" STEEL PIPE is MECHANICALLY Lined and Coated-and-Wrapped at the Mills under ideal conditions. Use your letterhead and write for a copy.

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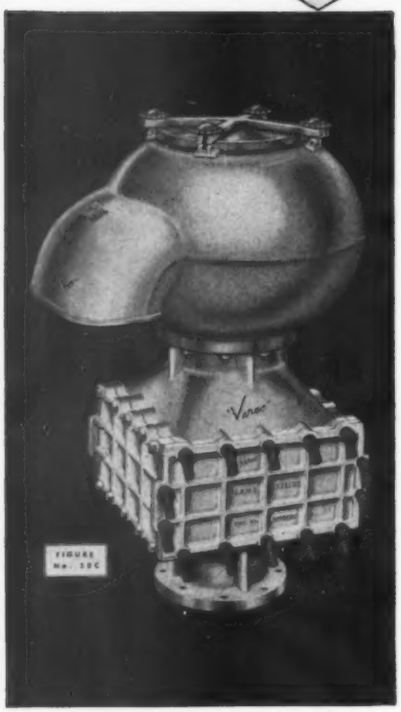

"VAREC" APPROVED PRESSURE RELIEF and VACUUM BREAKER VALVE with FLAME ARRESTER for use on Digester and Gas Holder Domes

This unit gives positive Pressure and Vacuum relief with safety, economy, and efficiency. Entire unit is self-contained and fully protected from the elements. Manufactured of pure aluminum, it is non-corrosive in sewage gas. Electrolysis is eliminated as the potentials of all component parts are in equilibrium. Easy to inspect and maintain. Fully streamlined throughout all passageways, it has maximum flow capacity per unit of pressure drop. Available in 2 to 10-inch sizes with fixed or variable settings.

"VAREC" Equipment has found universal usage and has become standard wherever toxic or combustible gas is encountered as is common to the sewage treatment industry. All "VAREC" products are guaranteed to give satisfaction for the service recommended and against defects in workmanship and materials.

"VAREC" *Approved* PRODUCTS

PRESSURE RELIEF AND FLAME TRAP ASSEMBLY • FLAME TRAP ASSEMBLY • PRESSURE RELIEF AND VACUUM BREAKER VALVES • FLAME ARRESTERS • WASTE GAS BURNERS • FLAME CHECKS • BACK PRESSURE REGULATORS • PRESSURE (REDUCING) REGULATORS • CHECK VALVES (NON-CHATTERING) • SEDIMENT TRAPS • DRIP TRAPS • MANOMETERS • PRESSURE (EXPLOSION) RELIEF VALVES • MANHOLE COVERS • HANDHOLE COVERS • SAMPLING HATCHES

Just Off the Press . . .

"VAREC" Sewage Catalog S-3 is now ready to solve your gas control problems with safety.

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all on facing pages, thereby minimizing cross references to other pages.

Additional features of the catalog are recommendations for the selection of valves and fittings, suggestions for operation, care and maintenance of valves, and much useful engineering data. For copy of Catalog No. 63 write The Kennedy Valve Manufacturing Co., 1197 East Water Street, Elmira, New York.

Equipment for the Halvorson-Smith Process of sewage filtration is treated at considerable length in a profusely ilustrated bulletin of Lakeside Engineering Corp. Beside descriptions of equipment, installations, and operation, there are working formulas, tabulated results of treatments at various plants, tabulated recommendations for installations of various sizes to treat B. O. D. concentrations of 300 and 400 P.P.M., a short section on operating costs, a list of "Important Don'ts," recommended "Distribution Specifications," a chart for determination of pumping costs, and a list of installations arranged alphabeticaly by states and cities. An introductory statement lists ten Advantages of the Aero-Filter Process. The slogan on front cover is "Low Momentary Rate—High Daily Capacity." The designation is Bulletin 108, and the title, "Aero-Filter." Lakeside Engineering Corp., 222 W. Adams St., Chicago, Ill., will mail copy on request.

Comminutor Design, Installation and Use are treated with great thoroughness in a recent Chicago Pump Company bulletin. Starting with a list of nine advantages of comminution, there follow photographs and diagrammatic illustrations of comminutors; directions for the selection of comminutor size and settings; a short discussion of location; six pages of comminutor capacity curves; a discussion of layout, arranged for use conveniently with numerous side heads in black type; eighteen pages of detailed and dimensioned plans and section of channels, wet wells, etc., for both single and duplex installations; sectional drawing of a comminutor; a specification form; a list of data required by the manufacturer's engineering department as a basis for installation recommendations; rules for estimating sewage flow; velocity and discharge diagrams for circular sewers and rectangular channels; and a list of comminutor installations arranged alphabetically by states. A table of contents is conveniently located inside the front cover. This 48-page book, listed as "Bulletin 185-A," and bearing the title "Chicago Comminutor Engineering Bulletin," may be obtained from Chicago Pump Co., Sewage Equipment Division, 2336 Wolfram St., Chicago, Ill.

Liquid Level Meters are described in a new 8-page bulletin covering six different styles of mechanical and electric operated liquid level meters just published by Cochrane Corporation, Philadelphia. Four electric operated types designed for remote service, including float, differential pressure, and bourdon spiral systems, are included in the bulletin. The potentiometer type meter described on page 3 is a new design. The Selsyn circuit previously used in this electrically operated float type meter has been discontinued. This potentiometer circuit is the same as used with the Cochrane remote flow indicators. Application drawings and technical data are conveniently arranged in sections devoted to each of the various available instruments. A liquid level meter serves to provide records that supplement those of fluid flow, pressures, temperatures, etc., thus enabling the owner to obtain the complete facts with regard to operating conditions and performances of main equip-

ment and processes. Write Cochrane Corporation, 3137 N. 17th St., Philadelphia, Pa., for copies of the new liquid level bulletin, Publication 2990.

Silica Removal from Water by the Permutit "Magde-Sil" Process is the subject of a clear and well illustrated bulletin issued October first. The bulletin was prepared after several years of research to develop a process for removing silica from high pressure boiler feed water. The process was perfected and is already in successful operation. This bulletin describes it in detail and shows how the silica content of any water can be reduced to any value, using moderate amounts of low cost reagents which do not add soluble by-products. Also, it shows how this process can be adapted to either hot or cold lime soda treatment and applied to either new or existing equipment. Designated Bulletin No. 2377, this publication may be had on application to The Permutit Company, Dept. G 1, 330 West 42nd St., New York, N. Y.

Flocculation Control. Another attractive publication concisely but clearly showing the character and method of operation of water and sewage treating equipment has been received from the Jeffrey Manufacturing Co., 996 - 99 North Fourth St., Columbus, Ohio. The subject is the "Jeffrey Floctrol Process"; and text, photographs and diagrams are combined to give the necessary general information. Tables and diagrams are provided for use in the design of coagulation and sedimentation tanks and basin. In writing, ask for Bulletin 746, "Floctrol."

Chlorine Gas Control Equipment in modern streamlined designs is well illustrated and described in a folder received at this office. Automatic electric proportioning, with remote control and remote recording are featured "STERELATORS" is the well-known name aplied to these units by their producer, Everson Manufacturing Co., 233 W. Huron St., Chicago, Ill.

Economical Ammoniation is the subject of a recent letter-size folder which may be had from Proportioneers, Inc., 9 N. Codding St., Providence, R. I. The folder states briefly the "Where, Why and How?" of the use of Aqua Ammonia and Proportioneers Amm-O-Feeders in either large or small plants. Photographs and diagrams add to the presentation.

"Elastic Stop Nuts" are those interesting nuts with resilient non-metallic self-locking inset collars. They are described and pictured in a novel manner in a folder from Elastic Stop Nut Corporation. In illustrated fashion appear 12 reasons for using such nuts, which are secured against loosening by machinery vibration or bolt stretch. "How they work and why," is an interesting story of a simple but valuable nut improvement which can mean so much. Their use eliminates all need for spring washers or lock nuts. They may best be defined as ordinary nuts with a resilient grip. For a copy of this worth noting folder, write Elastic Stop Nut Corporation, 2330 Vauxall Road, Union, N. J.

"Bar Stock Valves" are the subject of a new booklet from the Reading Pratt and Cady Div. of the American Chain and Cable Co. It contains very complete information, dimensions, and application recommendations for bronze, carbon steel and stainless steel Bar Stock Valves. These valves are developed for their high strength and close control, withstanding wide range or pressures and temperatures. They are precision machined directly from bar stock metals. Sleek in their stream-lined form, they are equipped with the new cross-bar type of hand wheel. Other R. P. & C. valves and fittings are pictured in the rear of the booklet. For a copy of "Bar Stock Valves," write Reading Pratt & Cady Div., Reading, Pa.

THREE ESSENTIALS for LASTING PIPE PROTECTION

most ferrous pipe must be COATED TO RESIST CORROSION

More than 25 years' experience shows that most types of ferrous pipes break down when exposed to the destructive action of soil corrosion. Such pipes give low-cost service only when protected with a corrosion-resistant coating.

coatings must be WRAPPED FOR REINFORCEMENT

The toughest coating can be seriously damaged by soil stresses and earth loads. To keep maintenance from becoming a problem, the coating must be shielded or reinforced with a durable wrapping.

the best wrapping is ASBESTOS PIPE-LINE FELTS

Made of asbestos fibers—inorganic and non-tubular—J-M Pipe-Line Felt cannot support capillary action. Strong and durable, it effectively prevents distortion and abrasion of coatings. Its high corrosion resistance assures efficient protection for coatings—minimum upkeep costs.

• • •

YOU'LL BE INTERESTED in learning how J-M Asbestos Pipe-Line Felts add years to the life of pipe under any service conditions. For details, write Johns-Manville, 22 E. 40th St., New York, N.Y.

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ASBESTOS PIPE-LINE FELTS

We refuse to drive in constant fear of blowouts

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we always carry a spare tire!!

A Statement by
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about Sabotage

LIKE all Americans we detest everything about sabotage. We even question if it is, at present, a serious menace to the water works of our country—*but we do believe in spare tires!*

On the same principle, we think it is just plain common sense for a water works to be prepared for ANY emergency which can disrupt the distribution of safe, pure water to our communities.

Hypo-chlorination is the best way to offset contamination quickly. Low cost Chlor-O-Feeders are ideal for emergency work in large plants as well as in smaller plants. Their simplicity and light weight enable them to be installed in a minimum of time. Their earned reputation for accuracy and dependability give you confidence . . . Our Amm-O-Feeders for large plants can be converted in 15 minutes into Chlor-O-Feeders.

As always, we stand ready to ship from stock upon receipt of your wire—*BUT your having a spare Feeder* for emergency work is more sensible. Can we help?

Jeff Corydon, *President*

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Sludge Conditioning
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35-45% Solution — Shipped in Tank Cars
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EQUIPMENT NEWS

A New Deep Well Automatic Water System

• Bulletin 260-B15, covering the R-C Auto-Jet line of deep well water systems, has just been issued by the Turbine Pump Division of Roots-Connersville Blower Corp., Connersville, Ind. The R-C Auto-Jet covers a range up to 1600 GPH, operating on a pressure differential of 20/40 lbs., and is suitable for well depths up to 190 ft. These pumps are built on the centrifugal jet principle, which eliminates all moving parts in the deep well casing and simplifies deep-well pumping, according to the manufacturers.

These units are priced complete with pressure tanks, including automatic air valve, pressure gauge, and pressure switch, but can be furnished without the tanks, if required. Off-set installations also are available at slight additional cost, according to the sales data issued by the company. Well seals, to comply with regulations in a few states, are optional at a nominal extra charge. The only moving part is a hydraulically balanced impeller, which is carried on bearings of the vertical motor. Simplicity of design and sturdy construction are also stressed throughout. According to J. B. Trotman, manager of the Turbine Pump Division, every effort has been made to simplify sales data so as to facilitate selection and conserve the time of jobbers' salesmen. R-C Auto-Jet pumping units supplement the turbine water systems for shallow wells which Roots-Connersville also manufactures.

"Hi-Co" a New Coating for Pipes

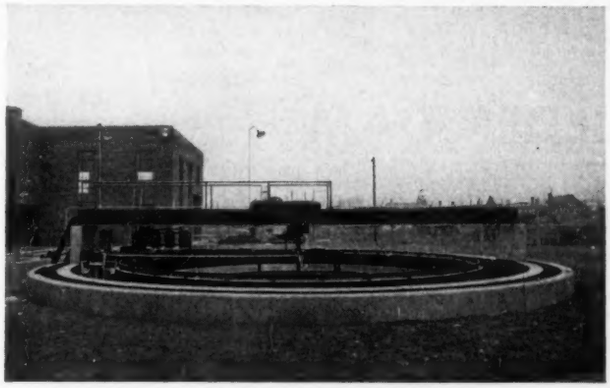
• During the recent convention of the New England Water Works Assn., R. D. Wood Co., of Philadelphia, announced a new protective lining for cast-iron pipes. This novel lining has been given the trade name "HI-CO," meaning sustained high coefficient of friction on high "C" valves.

As described in a paper presented before the Association this coating, which possesses several unique characteristics, is built up on the pipe interior after it has first been ground smooth, washed and heat dried. Thereafter an exact batch of molten coal tar, impregnated with an inert slate-flour binder, is sprayed onto the walls of the revolving pipe and evenly distributed by centrifugal action to a glossy finish. The pipe is then turned slowly in a flame until it reaches the flash point at which the tar cokes without igniting. This then constitutes the base, or substructure, for the subsequent finishing tar-coat. Into the honey combed coke base flows the final sealing tar coat to make an impenetrable protective bonded liner of marked smoothness. An interesting demonstration revealed the resistance of this new type lining (although thin in comparison to other coatings) to sulphuric acid and saturated brine, presenting adequate proof of the absence of pin holes which ordinary tar-dip coatings proved to have many of when submitted to the same tests.

The new coating having been put over the jumps, so to speak, by the Arthur D. Little Laboratories proves that "HI-CO" lining does not become brittle even at temperatures as low as 30° F. below zero nor do they soften at any temperature up to 140° F. On a friction test of a 300 foot line in actual service in Charleston, S. C., the "C" valve proved to be maintained at 148 to 151. (In laboratory tests the valve was 156 on original diameter and 166 on actual diameter.)

For descriptive literature presenting more details and interesting reading concerning this development of "coke reinforced" coal tar linings, write R. D. Wood Co., 400 Chestnut St., Philadelphia, Pa.

"MUNICIPAL" SAND FILTERS FOR SEWAGE AND TRADE WASTES



North Clarifier—Filter—South River, New Jersey

Municipal Sand cleaners are the only filter units that scour the sand and scrub the screen, removing bacterial growth.

Removal of suspended solids by filter 40 to 50%. Filter gives positive control of suspended solids in effluent and sedimentation period can be safely cut down, thereby greatly reducing cost of settling tanks.

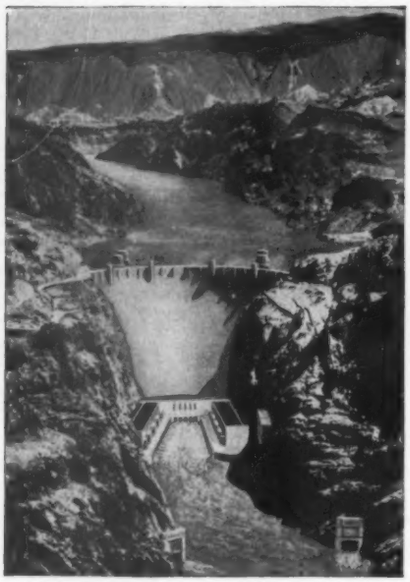
In one revolution of the sand cleaner practically all of the trapped solids are removed from the sand. Unless these solids are removed bacterial growth on sand and screen soon plug the filter.

Installations at:

South River, N. J. — Rutherford, N. J.
Somerville, N. J. — Sayreville, N. J.
Raritan, N. J.

MULTI-ZONE FURNACES for incineration of sewage sludge, screenings and ground garbage
and
DRYERS—for sewage sludge and industrial products
Are other products of

UNDERPINNING & FOUNDATION CO., Inc.
155 East 44th St. — New York, N. Y.



Bailey Meters AT

BOULDER DAM

● In Boulder Dam Power Plant as in many other new hydro-electric stations including Madden Dam and Norris Dam, Bailey Fluid Meters are installed on hydraulic turbines.

At Boulder Canyon, the Bailey Meters measure water supply through 13 foot diameter penstocks under an average head of 530 feet. These meters indicate and record the water flow in terms of cubic feet per second and continuously integrate in millions of cubic feet. The registers are operated by pressure connections in the turbine scroll casings.

While your project probably does not entail the volume and head of water that is being measured at Boulder Canyon, it is nevertheless, important that your measurements of flow and liquid level be accurately made by reliable equipment.

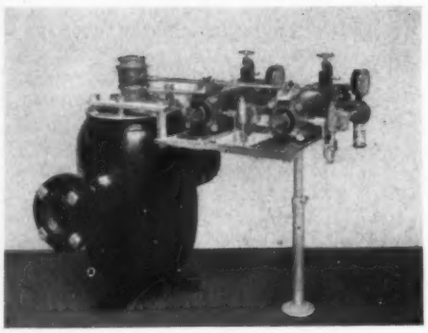
Write for complete information on the application of Bailey Meters to your problem. MU-19

BAILEY METER • COMPANY •

1072 Ivanhoe Road, Cleveland, Ohio

BAILEY METER COMPANY LTD., MONTREAL

New Automatic Duplex Solution Feeders



● A fully automatic duplex solution feeder, particularly adapted to chloramine treatment in small water works plants, has just been announced by Wallace & Tiernan Co. The unit consists of two automatic Hypochlorinators controlled from a single water meter; whenever the meter is operating, the two Hypochlorinators automatically apply chemical solutions to the water line in the required proportions for proper treatment. Solutions from the two Hypochlorinators can be applied at different points in the water line when it is necessary for one reaction to be completed before the other is begun. For chloramine treatment, one Hypochlorinator is used to feed hypochlorite solution, the other ammonia. If desired, the two Hypochlorinators can each be used for feeding different chemical solutions in the water works plant, or for industrial and plant applications.

These Hypochlorinators are essentially diaphragm pumps built of corrosion resistant materials, incorporating the regular features of W&T Hypochlorinators.

In the duplex unit, mounting design and the balanced diaphragm principle permit control of two Hypochlorinators from a single water meter without placing any appreciable load on the meter. As a result, accuracy of metering is unaffected, and it is unnecessary to resort to any power sources other than available main water pressures. Any type of meter in which a shaft turns in direct ratio to the flow of water through the meter may be used, and the chlorine and ammonia applied will at all times be proportional to the water flow. Variation in dosage is accomplished by varying the length of stroke, for which purpose a control handle and dial are provided for independent adjustment of each Hypochlorinator.

If it becomes necessary to remove one of the two Hypochlorinators for any reason, the other unit can be used for straight chlorination. Mountings for the duplex set-up are designed for easy installation, and the time required for installation of either a single unit or a duplex unit is only a matter of a few minutes.

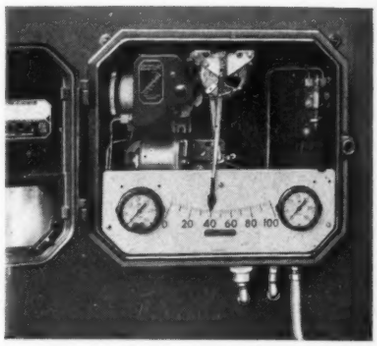
Complete information concerning the new automatic duplex solution feeder may be obtained by writing Wallace & Tiernan Co., Inc., Newark, N. J.

Proportioning Equipment for Corrosive Fluids

● The Cochrane air-actuated proportioner was designed especially for accurately feeding sulphuric acid in conditioning boiler feed water. A contact meter in series with a cycle controller operates an air compressor inside the proportioner shell when a predetermined flow is reached. The acid is measured into the dilution tank to which dilution water is proportioned by a simple but accurate mechanism that prevents abnormal chemical concentration, either too high or too low, usually associated with batch feeding. A special feed-line fitting provides for proper introduction of diluted acid or other fluid into the main flow.

For a more complete description of the design and operation of this proportioning system, write Cochrane Corporation, Philadelphia, for Publ. 2985.

Remote Pneumatic Transmission Systems



● A simple, accurate and economical means of indicating, recording or controlling process variables remote from the point of measurement is offered by the new Taylor remote pneumatic transmission systems. This system is particularly advantageous where it is desirable to correlate temperature, pressure, flow or liquid level data on a centralized panel or in a control room.

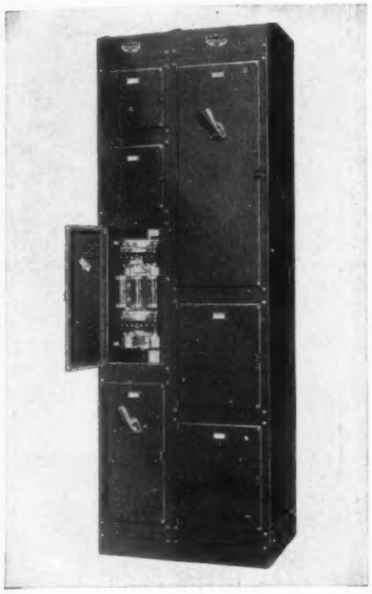
The system utilizes standard Taylor instruments. It may consist of one or two transmitters connected to a receiver; or one or more receiving instruments, not necessarily near each other, and as far as 1,000 feet from the transmitter. Transmitters or receivers may be indicating, recording or controlling types. Air pressure is the transmitting medium, with ¼ in. O.D. copper tubing as the connection.

Taylor remote pneumatic transmission systems are claimed by the manufacturer to be accurate within ± 1% of the scale range when properly installed. The speed of response of the receiver to changes in output air pressure from the transmitter is largely dependent upon distance—the maximum lag being 1 second per hundred feet of connecting tubing. There are no electric circuits.

Write to the Taylor Instrument Companies, Rochester, New York, for Bulletin No. 98156.

Sectionalized Motor Control

• "Unitrol" is the name given by Cutler-Hammer, Inc. to its new housings for motor control equipment. Built on the same principle as modern sectional filing cabinets, this development permits all needed types of control devices to be organized in locker-like motor control centers instead of the usual "pillar and post" method of mounting.



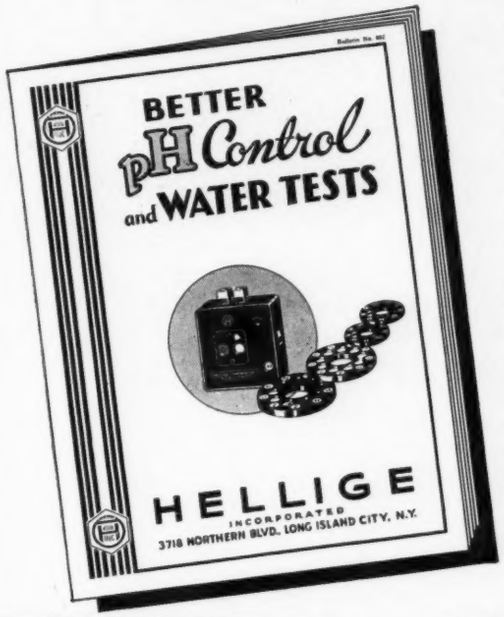
The standardized construction allows quick building up of any control center to meet present requirements, without special engineering. Future changes due to expansion, shop layout changes, etc. are quickly and easily taken care of by adding or removing sections, or by replacing the unit controllers.

With this construction, standard motor control units are mounted in standardized cubicle sections, made in 32 sizes, 8 widths, 4 heights (one depth)—for any desired combination of units. Standard units can accommodate controllers, disconnect switches and accessories as required. Control units can be mounted in both front and rear of the section giving double-sided construction and economy of space. The sections may be installed in a straight line, an L-shape or a U-shape.

Units are assembled either with all wiring busses, supports, terminals and interconnections already made, or with provisions for wiring on the job. Blank steel panels are furnished for any unused sections. Pushbuttons, meters and other accessories may be mounted on the blank panels. A door swing-out feature facilitates wiring and change-overs.

A descriptive booklet "UNITROL—the Next Step Forward in Motor Control" is obtainable from Cutler-Hammer, Inc., Milwaukee, Wisconsin.

WRITE TODAY FOR THIS INFORMATIVE FREE 28-Page BULLETIN No. 602!



A study of this bulletin would be to your best interest, as it would enable you to form an intelligent judgment as to what is best suited for a particular purpose in extending present equipment or in planning for an initial installation.

PERPETUALLY ACCURATE GLASS COLOR STANDARDS
NOW AVAILABLE FOR

pH Control, Color of Water, Ammonia Nitrogen, Nitrite Nitrogen, Nitrate Nitrogen, Chlorine, Iron, Dissolved Oxygen, Manganese, Lead, Phosphate, Silica, and Sulphides.

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HEADQUARTERS FOR COLOR STANDARDS AND COLORIMETRIC APPARATUS

YOU MAY HAVE A *Prize-Winning* IDEA
FOR THE
CLOW-NATIONAL
$1,000.00
"A Better Pipe Economy"
CONTEST

Write for Contest Folder. Address:—
Mr. Frank J. Egan, Manager
Cast Iron Pipe & Foundry Department.
JAMES B. CLOW & SONS
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CHICAGO, ILLINOIS

LEADITE
The Pioneer Self-Caulking Material for C. I. Pipe

"ALL OF THIS PIPE IS CAST IRON AND WE HAVE USED LEADITE FOR THE JOINTS"

Sizes of Pipe	Miles
4"	.328
6"	7.020
8"	28.086
10"	.935
12"	8.056
16"	2.662
24"	.338
30"	1.565
36"	.332
42"	.041
Total	**49.363**

Note—49.363 miles equals: 260,636.64 ft.

THE LEADITE COMPANY
Girard Trust Co. Bldg., Philadelphia, Pa.

No Caulking

SALESMAN ON HIS WAY

. . . . to mail W. B. Carter's order for 325,000 lbs. of *Tegul*-MINERALEAD! For *what?* Why for that big Wichita, Kansas, 33-mile pipe line job you've been reading so much about.

What *of* it? Turn to pages 492B-492C and get a load of information on how *good* jointing compound works.

Bell & Spigot **Flanged**

Cast Iron Pipe and Fittings

FOR

BAIN FILTER PLANT

AND

ADDITIONS TO DISTRIBUTION SYSTEM

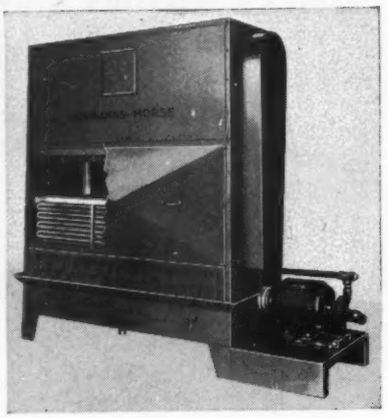
IN

RALEIGH

FURNISHED BY

GLAMORGAN PIPE & FOUNDRY CO.
LYNCHBURG, VIRGINIA

New Type Cooler for Diesel Engine Jacket Water



● As a result of the demand for a Diesel engine jacket water cooler of low purchase cost plus low operating cost, Fairbanks, Morse & Co. has designed a cooler using the principle of heat dissipation by evaporation of water. This device, considered to be the most economical so far developed, consists essentially of a coil through which the jacket water is passed, nozzles to spray water on the coil, and a blower to force air past the coils. In operation the hot jacket water enters the cooling coil at the top of the cooler, water from another source is sprayed over the coil from one end and air is blown in from the other end. As the water outside the coil evaporates, it cools the coil and the jacket water which is then returned to the engine. The sprayed water is constantly recirculated so that the actual amount consumed is only about 2 pounds per 1000 B.T.U. of engine heat absorbed.

The cooling coil is fabricated of ⅝-in. OD hard drawn copper tube hot tinned dipped. All coils are tested to 1000 lbs. pressure, submerged in water, and are free and clear of all foreign matter. All spray nozzles are bronze and are of the cleanable, swivel type placed on close centers to insure complete coverage of the entire coil surface. Frame assemblies are of angle iron electrically welded and hot dipped galvanized. Enclosing panels are of 16 gauge galvanized steel. Full-size access panels are provided to the coil chamber for easy inspection.

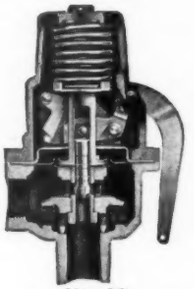
The F-M evaporative cooler is designed primarily for indoor operation although units for outdoor installation may be secured with cooling coils of the finned type to permit air cooled operation through the winter season. The finned type coolers may also be used indoors in the winter season to heat occupied spaces through branch lines of the air discharge duct.

New Type Safety Valve for Water Heating Boilers

● McDonnell & Miller, well known as manufacturers of boiler water feeders and low water cut-offs, have announced a new type of relief valve for hot water boilers. It has been developed to give the same protection to hot water boilers as McDonnell Water Level Controls give to steam boilers.

The new valve is known as the No. 29 Safety Valve, and is named for its relief point of 29 pounds. Its design departs sharply from usual construction in that the valve is designed to snap open to its full orifice capacity at the precise moment the relief point of 29 lbs. is reached. It then stays open, discharging its full capacity until the boiler pressure is reduced to 22 pounds, at which time it snaps to an instantaneous closure.

This instantaneous or "snap" action was developed, according to the McDonnell organization, to avoid the condition of a valve merely cracking at the relief point, permitting boiler pressure to build up to a dangerous level before discharge capacity became sufficient to level off or reduce the pressure. The manufacturer states that the "snap action" has proved, during four years of laboratory and field studies, positively to prevent pressure rising above 29 lbs. regardless of heat input.



No. 29

The illustration shows the cam-and-roller construction which carries out the snap action idea. When the pressure acting on the bellows reaches 29 lbs., the tip of the cam slips past the roller, permitting a level to trip the valve wide open, passing the full discharge capacity of the orifice. The flexible metal bellows takes the place of the diaphragm ordinarily used in relief valves. Another interesting feature is the factory adjustment which is said to prevent tampering. The valve is fully A.S.M.E. approved.

An interesting bulletin is available which contains pressure charts and other test data taken from years of research. It may be obtained by writing to the home office of McDonnell & Miller, Wrigley Building, Chicago.

New Jet Pump Motor

● A new fractional-horsepower capacitor-motor for jet pumps has just been announced by General Electric Co., Schnectady, N. Y. Perhaps the most outstanding feature of this motor, which is available in sizes from 1/6 to 1 horsepower, 3450 rpm, is its design for through ventilation. Openings in the pulley-end end shield permit cool air to be forced through the stator, thus providing cooler operation and excellent motor performance. Another improvement is the built-in capacitor in the end

shield, which gives the motor smoother lines, thus contributing to more attractive-looking jet pumps.

The new motor makes use of a cast aluminum rotor; ball bearings which are suitable for vertical operation, and which are packed at the factory with sufficient lubrication to last two years; and thermal overload protection. This protection is provided by an overload protective switch mounted in the end shield which protects the motor from damaging overloads and automatically resets when the motor cools.

New Line of Angleflow Pumps

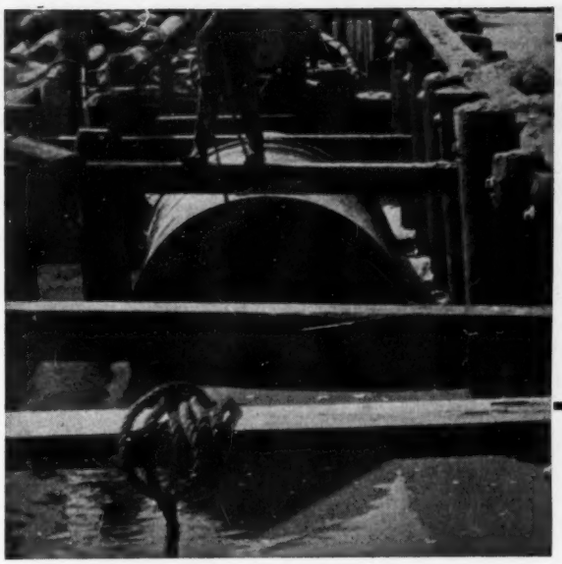
• An interesting 16-page Bulletin, No. 5710, illustrating and describing their new line of Angleflow Pumps in both vertical and horizontal types, has been released by Fairbanks, Morse & Co., Department 133, 600 S. Michigan Ave., Chicago, Ill. This announcement will be of particular interest to consulting engineers, industrial engineers and others concerned with large capacity pumping operations, such as land drainage, flood control, irrigation storm water disposal, municipal pumping, excavation unwatering, coffer dams, dry docks, condenser circulating, etc.

R. V. Cook, Manager of the Pump Division of the company, says, "The large capacity low head pumping equipment which has been available in the past was either of the radial flow Francis runner type or centrifugal pump, or the axial flow diffuser type of propeller pump. This Fairbanks-Morse Angleflow Pump line combines the advantages of both of these types and is technically a design about half-way between. The hydraulic stream flow through the impeller is at an angle to the axis of rotation (center of pump shaft). This is where the pump gets its name.

"The stream leaves the impeller and enters a volute where the velocity imparted to the stream by the impeller is recovered in the form of pressure head, and in the same manner as any other volute or centrifugal type pump. Since a volute is used for the velocity recovery, no diffusers such as are employed in propeller pumps are necessary. This makes the unit suitable for many applications where there is some flexible trash such as dirt, silt, sticks or stones or other foreign matter in the water being handled. It also eliminates the shearing effect which is always present between the back side of the rotating propeller blade and the front side of the stationary diffuser blade in the propeller type of pump."

Both vertical shaft and horizontal shaft types of Angleflow Pumps are provided in standard sizes up to 54-in. discharge, and in special larger sizes, depending upon the job requirement.

This type of pump is adapted to large capacity installations in the lower heads, where continuous trouble-free service at low power cost and upkeep cost is more important than the mere pump plant cost.



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FLEXIBLE JOINT PIPE
BELL & SPIGOT PIPE
SPECIAL CASTINGS
SHORT BODY BELL & SPIGOT SPECIALS

Large stock enables us to make prompt shipments.

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SIZES 2" TO 84"

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11 Broadway, New York

Warren Pipe Company of Mass., Inc.
75 Federal St., Boston

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■ From tip to toe, the new Bain Filtration Plant of Raleigh, N. C., has been protected and attractively decorated with Inertol Products.

■ Watertight basins, rust-free pumps and equipment, spotlessly clean and dry floors, mold-free walls and ceilings . . . these are the outstanding features of any Inertol job in Water Works and Filtration Plants.

■ Inertol Enamels look and wear almost like tile! Write for full particulars and references to:

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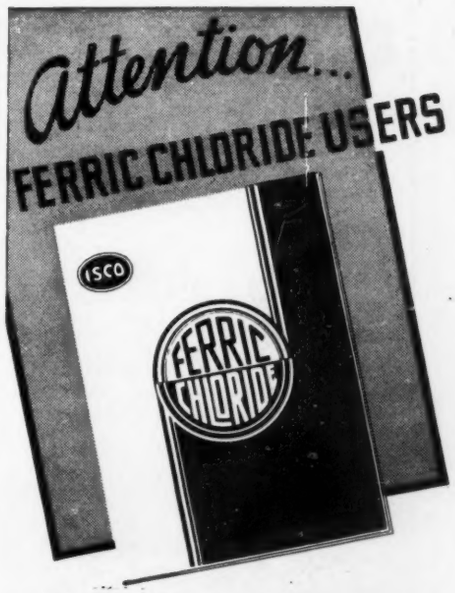
COMPANY, INC.
401 Broadway, New York, N. Y.
Branch: 64 South Park, San Francisco, Calif.
Agents in principal cities



This brand new booklet contains a wealth of information and data which every ferric chloride user should have. A copy is yours for the asking, with our compliments.

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Plant: Niagara Falls, N. Y.

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Smallest Diaphragm Pump Made, 2" Suction Open Discharge. Capacity 1400 G.P.H. Weight 50 lbs.

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Catalog "T" Gives Full Data, Also Edson Hand and Power Pumps, Suction Hose and Pump Accessories

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ACTIVATED ALUM CORPORATION
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WITH THE MANUFACTURERS

John Woodson Joins National C. I. Pipe Co.

John Woodson

John T. Woodson, for several years connected with the Lynchburg Foundry Co., Lynchburg, Va., has recently become associated with the National Cast Iron Pipe Division of Jas. B. Clow Co. in Birmingham, Ala.

Mr. Woodson assumes the position of Associate Southern Sales Manager, and will handle sales in the Southeastern territory.

This advice has come from Paul A. Ivy, Jr., Ass't. Gen'l. Sales Manager for National Pipe.

Allis-Chalmers to Build World's Largest Turbo-Blowers

• The Allis-Chalmers Mfg., as low bidder, has been awarded a $550,000 contract by the Sanitary District of Chicago, to build the three largest turbine driven blowers for sewage aeration in the world.

These large blowers each will have a capacity of 115,000 cubic feet per minute at 8½ pounds gauge. Each will be direct connected to a 5200 hp. steam turbine, and each will have its own condensing unit, connecting piping and air check valves. This installation will treat about 660,000,000 gallons of sewage per day.

Eimco Moves to Larger Offices

• The Eimco Corporation of Salt Lake City, has moved their Chicago Sales Office into larger and more adequate quarters in the Conway Building, 111 West Washington St., Chicago.

NEED A TRENCHER?
Investigate this rebuilt P&H ladder-type trencher. It carries a new machine guarantee. Digs 42" trench to depth of 20'. Powered by 90 h.p. Waukesha gas engine. Can ship in 10 days. Located in Milwaukee. Cash or terms. Write Box No. 100, Water Works & Sewerage, 330 So. Wells St., Chicago, Ill.

THE ENSLOW STABILITY INDICATOR

Provides Continuous Corrosivity Index

Base weighing 12 pounds can be removed, permitting wall mounting. Well constructed throughout. Art Metal Finish.

Write for Full Details

Phipps & Bird, Inc.
RICHMOND, VA.

WILSON CHEMICAL FEEDER

Outstanding features are quick feed adjustment, visible valves, flexible cylinders; feeds against 150-lb. pressure, and proof against corrosive chemicals.

Motor driven, positive displacement, pump type feeder. It is illustrated as a constant rate feeder though also furnished as Type MD-H with fluid meter control, and when so arranged is a measure-to-measure proportioning feeder.

This is a sturdy, dependable heavy duty feeder.

Write for Bulletin
Wilson Chemical Feeders, Inc.
BUFFALO, NEW YORK

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GASKET AND FORM
The Perfected Method for Making SEWER PIPE JOINTS OF CEMENT

- No jute used—gasket centers spigot.
- Definite space in each joint for cement.
- Form confines cement-grout to lower portion of joint.
- Particularly advantageous in water-bearing trenches.
- Infiltration minimized.

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The Standard Material

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Underground Mains

THE CAST IRON PIPE RESEARCH ASSOCIATION

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Michigan Alakali Celebrates Golden Anniversary

• On October 17th Michigan Alkali Co. of Wyandotte, one of Michigan's pioneer industrial firms, celebrated its 50th anniversary by being banquet host to 567 of its employees with a service record of 25 years or more. And every one of the 567 also received from the president of the company, Emory L. Ford, a gold watch.

Michigan Alkali Co. was founded Oct. 17, 1890, by Captain John B. Ford. Emory L. Ford, the present head of the company, is his grandson and John B. Ford, Jr., a great-grandson, is vice-president.

Dr. Cunningham Joins the Columbia Alkali's Technical Service

• Dr. G. L. Cunningham has recently joined the technical service department of The Columbia Alkali Corporation, of Barberton, Ohio.

Dr. Cunningham, since 1930, has been research chemist at Mathieson Alkali Works, Inc., Niagara Falls, N. Y. He hails from Spartanburg, S. C., is a graduate of the University of South Carolina (1927) and received his Ph. D. degree at the University of Virginia in 1930.

A. D. McLean, Vice-Pres. of Pittsburgh Meter Co.

• The Pittsburgh Equitable Meter Company, has announced the election of Mr. A. D. MacLean to a Vice Presidency in the Company.

Mr. MacLean is a graduate of the School of Engineering, Harvard University. Immediately upon receiving his degree, he enlisted in the Army Air Service Corps, serving therein until the Armistice in the World War. In 1926 he was Ass't. Chief Engineer of the New Departure Division of General Motors. The same year he joined the EMCO organization as Chief Engineer, which position he has filled until the present date.

Announcement of Mr. McLain's advance has come from Col. W. T. Rockwell, President of Pittsburgh Equitable Meter Co.

REAL SURFACE PROTECTION
with **SHERWOOD'S** specifications is
ECONOMICAL, EFFECTIVE and **DURABLE**

R S P ASPHALT EMULSION FOR ROOF COATINGS
R S P SEMI-MASTIC FOR NON-SLIP FLOORS
R S P PLASTIC FOR EXPANSION JOINTS AND CAULKING

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Special instructions are gladly supplied for the many uses for these exceptional products. We invite your questions on waterproofing problems of any nature and assure you of our cooperation.

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An effective and low cost method of preventing corrosion in water tanks.

RUSTA RESTOR will prevent further corrosion of underwater surfaces. Effective whether tank has been painted or not.

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IF Your SEWAGE effluents are high in suspended solids;

Or, you have a WATER PROBLEM;

Or, desire to RECOVER a product now wasted;

Or, you are disturbed by STREAM POLLUTION;

Or, are in any way interested in the removal of suspended solids from liquors;

You should investigate the

Laughlin Modified Rapid Sand Filter

BECAUSE, it is a simple automatic, continuous flow apparatus, designed on familiar lines, to accomplish a purpose without adding to the operator's troubles.

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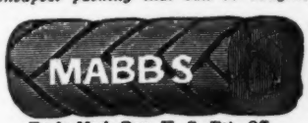
Prevent wear and cutting of rods, plungers, shafts and valve stems by using

MABBS RAWHIDE PACKING

In Your Water Works and Sewage Plants

IT LASTS LONGER — *Is Anti-Frictional, Saves Power, Labor and Repairs. Will prove the cheapest packing that can be bought.*



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Incorporated 1892
431 S. Dearborn St., Chicago, U. S. A.

The Meter-Master

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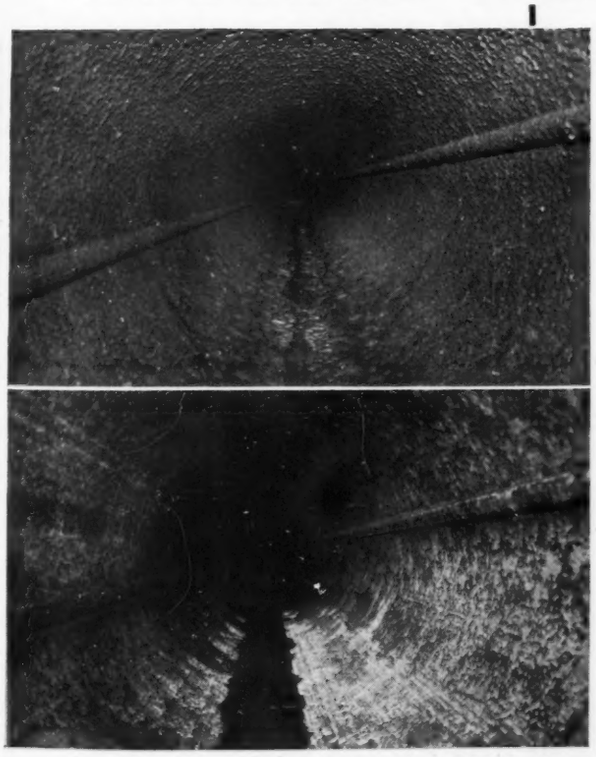

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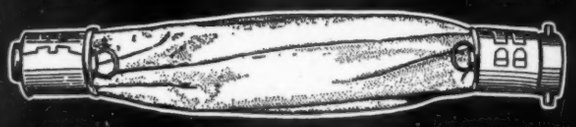

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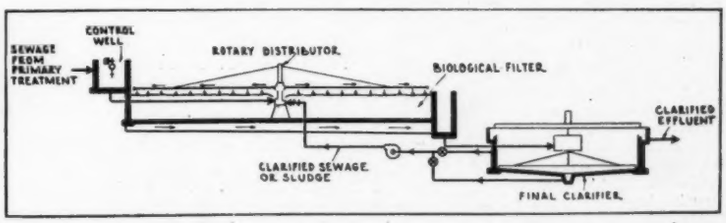

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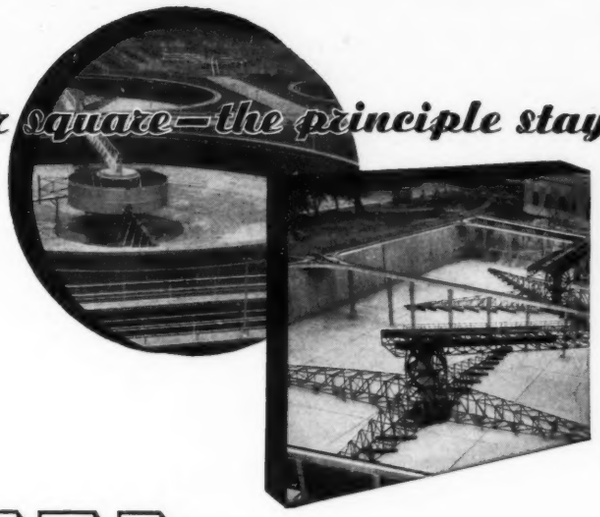

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